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Human Disturbances of Waterfowl: An Annotated Bibliography

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Abstract. The expansion of outdoor recreation greatly increased the interaction between the public, waterfowl, and waterfowl habitat. The effects of these interactions on waterfowl habitats are visible and obvious, whereas the effects of interactions that disrupt the normal behavior of waterfowl are subtle and often overlooked, but perhaps no less harmful than destruction of habitat. Resource managers and administrators require information on the types, magnitude, and effects of disturbances from human contact with wildlife. This bibliography contains annotations for 211 articles with information about effects of human disturbances on waterfowl. Indexes are provided by subject or key words, geographic locations, species of waterfowl, and authors.

Key words. Aircraft, bibliography, boating, fishing, human disturbances, hunting, recreation, refuges, waterfowl.

Increases in human population, transportation, recreational boating, industrial and residential development, birdwatching, camping, and hiking create conflicts with waterfowl which must use a dwindling and fragmented habitat base. Managers and administrators require information on the types, magnitude, and potential effects of disturbances by human contact with wildlife. Wildlife managers should be aware of the problems from human disturbance and consider them in the design of public facilities.

This bibliography resulted from concerns about human disturbance of flocks of canvasback ducks (*Aythya valisineria*) and other waterfowl that stage on navigation pools of the Upper Mississippi River during fall migration. An earlier field study and literature search for another manuscript about these disturbances (Korschgen et al. 1985) indicated few specific studies on the subject, but numerous anecdotal references. Aspects of human disturbance of other groups of wildlife, especially large game mammals (Bollinger et al. 1973; Ream 1980; Ferguson and Keith 1982) and nesting seabirds and shorebirds (Hunt 1972; Robert and Ralph 1975; Buckley and Buckley 1976; Manuwal 1978; Rodgers and Burger 1981; Burger 1981; Whitman 1988; Frederick and Collopy 1989; Strauss and Dane 1989; Yalden and Yalden 1990), received considerable attention because of the increased frequency of human–wildlife interactions in national and state parks, refuges, management areas, and seashores (Foin et al. 1977; Purdy et al. 1987; Pomerantz et al. 1988). Books have been written about the effects of human disturbance on natural resources (Edington and Edington 1986; Hammitt and Cole 1987). This publication is a source of consolidated information about human disturbances of waterfowl and intended for wildlife managers and administrators.

We searched *Wildlife Abstracts*, *Wildlife Review*, *Journal of Wildlife Management*, *Wildlife Society Bulletin*, and *Wildlife Monographs* for titles and key words on human disturbance. Unfortunately, few key words in journals relate to this topic. We also searched a bibliography of waterfowl papers maintained by Kenneth J. Reinecke (U.S. Fish and Wildlife Service, Patuxent Wildlife Research Center) with over 5,000 citations. Perhaps our most valuable sources of information were the reference sections of publications on human disturbances of waterfowl.

Some of the bibliographic entries are papers that are not about waterfowl, but topics that may be important for further research on waterfowl.

The definition of human disturbance of waterfowl varies by author. A reasonable definition that we prefer is an intentional or unintentional action that elicits alertness; obvious or inapparent fright; interruption of activities; flight, swimming, or other displacements; or causes death or disablement. The disturbance may have long- or short-term effects. We excluded almost all references on death of waterfowl including legal or illegal harvest; waterfowl collisions with power lines; fatal ingestion of angler's lead sinkers; and fatal entrapment in commercial fish nets, trotlines, and furbearer traps. Exclusion of some such material was so awkward that we included it. However, we confined information chiefly to direct disturbance from humans such as presence, traffic, flights, fishing, and boating.

We included several papers on waterfowl energetics because disturbances may hinder the acquisition of food which, in turn, may affect physical fitness for migration and breeding. Energetics is a rapidly developing topic with important information about unanswered questions of the effects of disturbance on waterfowl.

Disturbances by water users, chiefly boaters, anglers, and hunters, are mentioned most frequently (Table). These disturbances were serious because they displaced waterfowl from their feeding grounds, created energetic costs for flight, and may have lowered productivity by flushing nest-

Table. *Frequency with which subjects are cited.*

Subject	Number of citations
Abatement, mitigation, or alleviation	30
Aircraft	
Airplanes	15
Helicopters	10
General	22
Anglers (see fishing)	
Baiting or artificial feeding	7
Barges or shipping	9
Boating (boats, canoes, sculling, rowing, power, airboats, sailing)	66
Breeding chronology	2
Brood breakup	14
Brood rearing	7
Cats	2
Development (industrial, petroleum, pollution, urban, construction)	24
Dogs	6
Energetic costs (flight)	23
Family breakup	6
Farming	19
Feeding (natural)	52
Fishing	
Commercial	
General	2
Nets (trammel)	2
Trotlines	1
Lead weights (fishing or angler's)	2
Sport (angling)	50

Table. *Continued.*

Subject	Number of citations
Hazing (scaring)	12
Human activity or disturbance, general	58
Hunting	
Family breakup	2
General	69
Investigator or research	
Nest disturbance	55
Increased predation	31
Military	5
Molting	9
Native use	2
Nest (see Investigator or research-caused)	
Disturbance	27
Success	14
Noise	22
Recreation	
General	18
Water-based	27
Refuge (restricting trespass, sanctuary—see Abatement)	36
Research (see Investigator or research)	
Roads (also see Development)	
General	10
Traffic	11
Sanded dead	2
Shipping (see Barges or shipping)	
Trains	1
Trapping	
Furbearer	1
Waterfowl	5
Wariness (tameness, alert, tolerance distance)	43

ing or brooding hens. Researcher-caused disturbances also had a high frequency of occurrence. Most biologists are familiar with desertions of nests by hens that are disturbed by investigators.

We hope this bibliography stimulates research on topics with the least available data. Although this bibliography is incomplete, it provides a starting point for the reader interested in human disturbances of waterfowl.

Acknowledgments

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Annotated Bibliography on Human Disturbances of Waterfowl

1. Atkinson-Willes, G. 1969. Wildfowl and recreation: a balance of requirements. British Water Supply 11:5–15.

   The author accepts human disturbance of waterfowl as a given and proposes compromises by recreationists to maintain the important role of Great Britain as wintering habitat for European waterfowl. Suggestions for compromises are offered. Effects of sailing, canoeing, rowing, water-skiing, speedboating, hydroplaning, fishing, bird-watching, picnicking, and shooting on waterfowl and how resource use might be partitioned are addressed. The publication has no literature-cited section.

2. Austin, J. E. 1988. Winter ecology of Canada geese in northcentral Missouri. Ph.D. thesis, University of Missouri, Columbia. 284 pp.

   Canada geese (*Branta canadensis*) tended to spend more time in agricultural habitats, where they were more vulnerable to disturbances than in seasonal wetlands in the refuge interior or the water roost sites. Vigilance of waterfowl did not differ by habitat in the hunting season, thus the effects of disturbances by hunters are far-reaching. All use of wetlands in late fall occurred in the refuge interior, which is not hunted. However, in response to gunshots from the hunting zone, geese in the refuge interior often ceased other activities and, at least briefly, became alert or vigilant. Habituation of Canada geese to disturbances in some locations may account for the lower vigilance of geese on pastures in winter. These pastures seemed to be traditionally used by geese and may be considered safe fields. Geese seemed to avoid or leave locations where excessive disturbances restricted feeding and where they did not habituate to disturbances.

3. Bálat, F. 1969. Influence of repeated disturbance on the breeding success in the mallard, *Anas platyrhynchos* Linn. Zoologicke Listy 18:247–252.

   In a 10-ha bottomland forest, 98 mallard nests were found and regularly inspected. The nests were in willows (*Salix* spp.). After first arousal from nests, mallards became much more sensitive to approaching humans. Bodies of water inside that forest were visited by sports anglers who stay there from early morning until dusk on nonworking days. Aroused mallards did not return to their nests for several days. Fifty-six (57.2%) hens abandoned clutches, including eggs shortly before hatching, and three hens abandoned hatching young. On the contrary, where incubating hens were not disturbed, the number of abandoned nests was low.

4. Barngrover, L. 1974. W. E. Kirch Wildlife Management Area resource inventory and long range plan summary. Nevada Department of Fish and Game. 12 pp.

   In the late 1950's the Nevada Fish and Game Commission recognized the value of what is now the Kirch Wildlife Management Area. In April 1959, the area was purchased primarily for waterfowl with Pittman–Robertson funds. Fishing is the most popular activity on the management area in terms of public use days. A conflict apparently exists between anglers and the production of waterfowl in prime waterfowl habitat. Fishing regulations should be modified to assure maximum waterfowl production.

5. Bartelt, G. A. 1987. Effects of disturbance and hunting on the behavior of Canada goose family groups in eastcentral Wisconsin. Journal of Wildlife Management 51:517–522.

   Disturbances of roosting areas increased separation of family members of Canada geese in 1979 and may have contributed to the large number of family members shot during the hunting season. The cohesiveness of family groups was disrupted after a family member was shot. Families (after hunting losses) and random groups used the same roosting areas less as the season advanced. Intact family groups used the same roosting areas at the same rate throughout the season. A disintegration of family structure seemed to be related to the extent of disturbance and hunting pressure during the years of this study.

6. Batten, L. A. 1977. Sailing on reservoirs and its effects on water birds. Biological Conservation 11:49–58.

Despite intensified sailing, mallards (*Anas platyrhynchos*), common pochards (*Aythya ferina*), and tufted ducks (*A. fuligula*) still used the Brent reservoir in autumn and winter because part of the shallow and marshy reservoir was not accessible to boats. During autumn 1975, Canadian pondweed (*Elodea canadensis*) choked the northern arm of the reservoir and precluded boating after August, resulting in a build-up of 159 common pochards, 30 tufted ducks, 17 northern shovelers (*Anas clypeata*), and 12 gadwalls (*A. strepera*). Distances at which flocks of ducks moved from an oncoming dinghy were an estimated 275 m by tufted ducks and 450 m by common pochard. The dinghy came within 100 m of small groups of smew (*Mergellus albellus*). Mallards behaved like smews. Green-winged teals (*A. crecca*), Eurasian wigeons (*A. penelope*), and northern shovelers were more sensitive than mallards. Green-winged teals and Eurasian wigeons stopped using the reservoir because of sailing. Perhaps screening vegetation on reservoir banks and large vegetated rafts would reduce disturbance.

7. BEARD, E. R. 1953. The importance of beaver in waterfowl management at the Seney National Wildlife Refuge. Journal of Wildlife Management 17:398–436.

As demonstrated in 1947, waterfowl will sharply decrease use of areas opened to public recreation such as fishing. During 1947, only two broods and 70 adult ducks were seen. In the 2 following years, however, when the marsh was closed to fishing, a marked increase in broods and adults was noticed. A portion of the study had the highest interspersion index (45/9) and was foremost in duckling production in 1948 and 1949, but not in 1947 when it was included in the open-to-fishing zone. Because of the constant disturbance from anglers, use of the marsh by ducklings was negligible.

8. BÉLANGER, L., and J. BÉDARD. 1989. Responses of staging snow geese to human disturbance. Journal of Wildlife Management 53:713–719.

In spring and fall of 1985–87 the authors studied the effects of human disturbance on staging snow geese (*Chen caerulescens atlantica*) in the Montmagny bird sanctuary, Québec. They recorded 652 disturbances (any event that flushed all or a part of the snow goose flock) in 471 h of observation. Rate of disturbance was higher in fall (1.46 per h) than in spring (1.02 per h; $P \leq 0.001$). The entire flock flushed in response to 20% of the disturbances. Mean time in flight was 56 and 76 sec in fall and spring ($P = 0.049$). Transport-related activities, particularly low-flying aircraft, caused ≥45% of all disturbances in spring and fall. Snow geese stopped feeding in response to 40% of all disturbances ($P \geq 0.05$). Mean time to resume feeding was 726 sec in fall compared with 122 sec in spring ($P \leq 0.001$). Level of disturbance on a fall day affected the use of the sanctuary by snow geese the following day ($P \leq 0.01$). When disturbances exceeded 2.0 per h, 50% fewer snow geese were present the next day. Low-level aircraft flights over goose sanctuaries should be strictly regulated.

9. BÉLANGER, L., AND J. BÉDARD. 1990. Energetic cost of man-induced disturbance to staging snow geese (*Chen caerulescens atlantica*). Journal of Wildlife Management 54:36–41.

Energetic cost of anthropogenic disturbance of fall-staging snow geese in Québec was estimated. Two responses of birds to disturbance were considered: (1) birds fly away but promptly resume feeding after a disturbance (Response A), and (2) birds interrupt feeding altogether (Response B). Daylight foraging time decreased by 4% to 51% depending on disturbance levels. Average rate of disturbance (1.46 per hour) in Response A resulted in a 5.3% increase in hourly energy expenditure (HEE) combined with a 1.6% reduction of hourly metabolizable energy intake (HMEI). In Response B, HEE increased by 3.4% and HMEI decreased by 2.9% to 19.4%. A 4% increase in night feeding could compensate for energy losses from sole disturbance flights (Response A), but a 32% increase in nighttime feeding was required to restore energy losses incurred in Response B. No increase in daily feeding rate was observed between days with different disturbance levels ($P > 0.05$). Authors concluded that anthropogenic disturbance had significant energetic consequences for fall-staging greater snow geese.

10. BELL, D. V., AND L. W. AUSTIN. 1985. The game-fishing season and its effects on overwintering wildfowl. Biological Conservation 33:65–80.

The trend in Great Britain toward extending the angling season may lead to increased encounters between anglers and wintering wildfowl. This paper considers the effects on wildfowl from the start of angling in March at Llandegfedd Reservoir. The reservoir is large, but anglers and waterfowl exploit the same restricted areas. Green-winged teals (*Anas crecca*), Eurasian wigeons (*A. penelope*), mallards (*A. platyrhynchos*), and common pochards (*Aythya ferina*) were driven from their usual feeding or roosting sites and departed from the reservoir prematurely. Temporary reserve areas are suggested at Llandegfedd Reservoir for wildfowl at the start of the angling season. The correlation coefficient between waterfowl numbers and availability of open grassland in each area shows the effect of angling in the following tabulation:

Species	Before angling activity	After angling activity
Wigeon	0.729*	0.038
Teal	0.784*	−0.034
Pochard	0.601*	−0.138

* Significant at 5% level (df = 11).

11. BENNETT, L. J. 1938. The blue-winged teal, its ecology and management. Collegiate Press, Inc., Ames, Iowa. 144 pp.

Freshly made paths, trampled grass and weeds, film wrappings, nest markers, and other disturbances in the immediate vicinity of a blue-winged teal nest were very likely to attract predators. Two nests (0.8%) were abandoned because of poor study technique during the early stages of work.

12. BERGER, T. R. 1977. The Berger report: northern frontier, northern homeland. Living Wilderness 41:4–33.

On the staging grounds, snow geese (*Chen caerulescens*) are highly sensitive to human presence, noise, and aircraft. Snow geese did not feed closer than 2.41 km (1.5 miles) from a device simulating noise of a compressor station, and birds flying over it diverted their course by 90° or more. Snow geese show evidence of being disturbed by an aircraft by flushing at a mean distance of 2.57 km (1.6 miles) from small aircraft, 4.02 km (2.5 miles) from large aircraft, and 3.70 km (2.3 miles) from small helicopters. They also flushed in response to aircraft flying at altitudes of 2,440–3,050 m (8,000–10,000 feet), the maximum height at which the test flights were conducted. Deliberate harassing chased flocks of snow geese from a 8.05 km by 16.09 km (5 mile by 10 mile) area in 15 min. Snow geese may avoid an area as large as 32.18 km^2 (20 square miles) around an operating drill rig, 45.06 km^2 (28 square miles) around an operating compressor station, and 402.25 km^2 (250 square miles) around an airstrip during takeoff and landing of aircraft.

13. BERGMAN, R. D. 1973. Use of southern boreal lakes by postbreeding canvasbacks and redheads. Journal of Wildlife Management 37:160–170.

Human disturbance of summer-molting ducks may impair their selection of lakes for the flightless stage. Disturbance by humans on Swan Lake was negligible and canvasbacks (*Aythya valisineria*) were widely distributed on the lake in summer. Dauphin Lake, however, was used for recreation by boaters and anglers and only a few hundred canvasbacks passed their flightless stage at Dauphin Lake well out in the lake far from the nearest food plants and intense boating. During fall, thousands of flying canvasbacks readily used the pondweed-rich southern end of the lake where few ducks were seen in summer. Human activity in this region was no doubt less frequent during fall than summer, but canvasbacks with the power of flight may be more tolerant of disturbance.

Similar circumstances could account for the paucity of summer-molting redheads (*A. americana*) at Sagemace Bay even though redheads intensively used nearby Long Island Bay. Sagemace Bay was proximal to the towns of Winnipegosis and Camperville and two roads paralleling the west and southwest shores, whereas Long Island Bay was relatively secluded.

14. BERRY, J. 1939. International wildfowl inquiry, Vol. II, The status and distribution of wild geese and wild duck in Scotland. Cambridge Press. 190 pp.

The disappearance of graylag geese (*Anser anser*) from Scotland is attributed to excessive disturbance from continual shooting, an aerial bombing range, increasing motor traffic and angling for trout in previously undisturbed lakes, destruction of eggs by farmers who do not want graylag geese in their oat fields, the demand for eggs by collectors who offer the hill shepherds good sums for nests, and disturbance by aircraft. The book has sections on greater white-fronted geese (*A. albifrons*), pink-footed geese (*A. brachyrhynchus*), bean geese (*A. fabalis*), brants (*Branta bernicla*), Canada geese (*B. canadensis*), and snow geese (*Chen caerulescens*). Section II of the book covers 21 species of ducks. The summary for ducks covers natural enemies (crows, gulls, swans, rats, stoats, angler fishes, and pike); destruction by people (oil pollution, stake-netting for fish, flight-netting, egg-taking, and excessive shooting); results of increasing traffic (road traffic, boats and shipping, and airplanes); and changes in available food supplies (agriculture, natural feeding, drainage and afforestation, and effects of climate).

15. BERRY, R. F. 1988. Disturbance to tundra swans by barge and boat traffic. Loon 60:92.

About 750 tundra swans (*Cygnus columbianus*) resting on the Wisconsin side of Pool 5 in the Spring Lake area of the Mississippi River left the water surface and departed from the area in a downstream direction because of the passage of a tow (barge). In another instance, about 2,500 tundra swans in the Weaver Bottoms between Swan and Mallard islands and Minnesota 14 were disturbed by two small boats; all observable birds left the Weaver Bottoms, formed V's and departed in a downstream direction.

16. BISHOP, R. A., AND R. BARRATT. 1970. Use of artificial nest baskets by mallards. Journal of Wildlife Management 34:734–738.

Abandonment of nests was responsible for most losses of mallard (*Anas platyrhynchos*) nests in this study. Disturbance by observers was believed to be partly responsible for the abandonment.

17. BLOKPOEL, H., AND D. R. M. HATCH. 1976. Snow geese, disturbed by aircraft, crash into power lines. Canadian Field-Naturalist 90:195.

On 8 May 1974, several thousand snow geese (*Chen caerulescens*) were feeding on a stubble field near Pilot Mound, about 145 km southwest of Winnipeg. The birds covered almost the entire field and some were feeding very close to a power line that bordered one side of the field. A light aircraft flying at an estimated height of 30–60 m (100–200 feet) approached the field and caused panic among the snow geese. They took wing and in a chaotic mass rushed off the field to the side with the transmission lines. As many as 75 geese were injured or killed because they struck the wires. Several reports of disturbance of snow geese by light aircraft in southern Manitoba have been reported, and some probably involved curious and ill-informed pilots whereas others were deliberate harassment.

18. BOAG, D. A., AND V. LEWIN. 1980. Effectiveness of three waterfowl deterrents on natural and polluted ponds. Journal of Wildlife Management 44:145–154.

In 1975, three types of waterfowl deterrent (a model falcon, a moving series of reflectors suspended from a frame, and a human effigy) were mounted on floats and tested for efficacy in deterring waterfowl from entering a series of small natural ponds in the boreal forest of Alberta. Only the effigy seemed to be effective; diving ducks of the genus *Aythya* were affected most. In 1976, the human effigy was tested on an artificial tailings pond that received aqueous and bituminous effluent from an oil sands extraction plant near Fort McMurray, Alberta. Twenty-seven effigies were deployed over the 150-ha pond. Their effectiveness was judged by comparing the number of dead waterfowl in this pond in 1975 without deterrents and in 1976 with deterrents. The number of dead waterfowl found in 1976 was lower than expected. Researchers assumed that this decline was due to the presence of the effigies.

19. BOLDREGHINI, P., L. CASINI, AND R. TINARELLI. 1988. Lo svernamento delle Oche nell'area delle Valli di Comacchio (The wintering of geese in the Comacchio area [Po Delta, Northern Adriatic]). Supplemento alle Ricerche di Biologia della Selvaggini 14:51–76.

    A comparative analysis of sites regularly or occasionally frequented by greater white-fronted geese (*Anser albifrons*), grayling geese (*A. anser*), bean geese (*A. fabalis*), barnacle geese (*Branta leucopsis*), and red-breasted geese (*B. ruficollis*), showed that hunting pressure was the main factor affecting use of sites by geese.

20. BORDIGNON, L. 1985. Effetti del disturbo antropico su una popolazione di germano reale *Anas platyrhynchos*. (Effects of human disturbance on a population of mallard *Anas platyrhynchos*). Avocetta 9:87–88.

    Mallards colonizing a constructed lake (0.47 km^2) in northwestern Italy were censused from 1977, when the lake was filled, to 1984. After 1980, the population had severely declined as a result of daily disturbance by 30–200 anglers on the shores.

21. BOSSENMAIER, E. F., AND W. H. MARSHALL. 1958. Field-feeding by waterfowl in southwestern Manitoba. Wildlife Monograph 1, The Wildlife Society, Washington, D.C. 32 pp.

    Hunting disturbed waterfowl on lake and upland feeding sites. Flocks were feeding northern pintail (*Anas acuta*) and mallards (*A. platyrhynchos*) dispersed from the easily accessible shores, and gathered in less accessible regions in the northeastern and southwestern portions of the lake. Because hunting from boats was banned, these concentrations of loafing ducks were rarely disturbed. Geese flew along established routes during autumn, but usually dispersed after a few days, probably because of hunting pressure in the fields. Geese also seemed to prefer the fields near the lake, but unlike ducks that were easily forced farther away, constantly used them from arrival until freeze-up, almost irrespective of weather or shooting. Flight schedules did not vary by disturbances by humans on the lake or in fields. However, in Montana (Girard 1941), in the British Isles (Pitman 1947), and in Illinois (Bellrose 1944), disturbances, chiefly from hunting, caused changes in flight routines to ensure undisturbed feeding. Hunting pressure at Whitewater Lake may have been too low to influence feeding schedules significantly.

22. BOUFFARD, S. H. 1982. Wildlife values versus human recreation: Ruby Lake National Wildlife Refuge. Transactions of the North American Wildlife and Natural Resources Conference 47:553–558.

    Summarizes the controversy over conflicts between recreation and breeding by wildlife at the Ruby Lake National Wildlife Refuge in Nevada. The author provides information on the 1978 suit by Defenders of Wildlife. In its decision, the U.S. District Court, District of Columbia (1978:10, quoted from page 556), stated: "Neither poor administration of the refuge in the past, nor prior interferences with its primary purposes, nor past recreational uses, nor deterioration of its wildlife resource since its establishment, nor administrative custom nor tradition alters the statutory standard. The Refuge Recreation Act permits recreational use only when it will not interfere with the primary purpose for which the refuge 'was established.' The prior operation of the refuge in a manner inconsistent with that purpose does not change the base point for applying the statute's standard." The first test of the Refuge Recreation Act (1962) set important precedents for lands managed for wildlife by the Fish and Wildlife Service. The act and court decision provided strong protection for wildlife from incompatible recreational pressures on National Wildlife Refuges.

23. BOUFFARD, S. H. 1983. Redhead egg parasitism of canvasback nests. Journal of Wildlife Management 47:213–216.

During 1980, failure of canvasbacks (*Aythya valisineria*) to breed was due mostly to human disturbance and cold weather rather than to egg parasitism by redheads (*A. americana*).

24. BOURGET, A. A. 1970. Interrelationships of eiders, herring gulls, and black-backed gulls nesting in mixed colonies in Penobscot Bay, Maine. M.S. thesis, University of Maine, Orono. 121 pp.

When Bourget's results are compared with those of two other investigators, the higher nesting success in 1969 was caused by two things. First, in Bourget's study 54% of nests were in the open, with 46% located under nesting shelters which afforded better protection against avian predators. Secondly, human interference in the 1969 study did not involve long periods of disturbance while searching for nests, as performed by Choate (1967) and Clark (1968). The study primarily involved observations from a blind that caused short periods of disturbance to the colony. During this study, the observer's interference affected the breeding chronology of herring gulls (*Larus argentatus*), great black-backed gulls (*L. marinus*), and common eider (*Somateria mollissima*). As a result of human disturbance the breeding cycles of all species were delayed. It is probable that human disturbance, the size of the gull populations, the proportion of herring gulls to great black-backed gulls, and the type of nesting cover have much more influence on common eider nesting success than eider nesting density on a given island.

25. BRAKHAGE, G. K. 1965. Biology and behavior of tub-nesting Canada geese. Journal of Wildlife Management 29:751–771.

In heavily populated areas, human activities can cause geese to desert nests. At Trimble, a waterfowl management area in Missouri, desertion was held to a minimum by regulating opening dates of fishing season and by closing nesting areas to trespassers. The author had no evidence that the presence of the investigator caused destruction of nests such as described by Hammond and Forward (1956) for dry-land nesting ducks. During the study, 45 female Canada geese (*Branta canadensis*) safely laid their clutches in ground nests and started to incubate. Humans and dogs destroyed eight nests, but 95% of the eggs in the remaining nests hatched successfully.

26. BRAUN, C. E., K. W. HARMON, J. A. JACKSON, AND C. D. LITTLEFIELD. 1978. Management of National Wildlife Refuges in the United States: its impacts on birds. Wilson Bulletin 90:309–321.

National wildlife refuges are in 49 of the 50 states and encompass more than 13,678,860 ha. Refuges are vital to the conservation of many birds. In 1974, fishing was allowed on 171 refuges and waters were stocked on at least 18 refuges. Excessive use of shallow vegetated areas of lakes and streams by wading and boating anglers can disturb feeding and nesting waterbirds. Various interest groups demanded and received access to 42 national wildlife refuges for motor boating and water skiing. Obvious and documented damage by high speed boating are degradation of shoreline, disruption of nesting and feeding waterfowl, and displacement of birds. Hunting of wildlife, primarily migratory waterfowl, was permitted on portions of 184 national wildlife refuges in 1974. On refuges with endangered species, such as whooping cranes (*Grus americana*) and Mexican ducks (mallards, *Anas platyrhynchos*), the rationale for hunting of lookalike species is obscure. Some refuges are practice areas for low flying military aircraft, others are convenient and inexpensive routes for highway and utility rights-of-way.

27. BROWN, P. W., AND M. A. BROWN. 1981. Nesting biology of the white-winged scoter. Journal of Wildlife Management 45:38–45.

    White-winged scoters (*Melanitta fusca*) are easily disturbed by human interference such as the recreational boating on lakes that white-winged scoters prefer for breeding. According to the senior author, recreational boaters stopped at islands and disrupted nesting, and water ski enthusiasts and power boaters ran over hens and broods.

28. BURGER, J. 1981. The effect of human activity on birds at a coastal bay. Biological Conservation 21:231–241.

    Jamaica Bay Refuge is part of the Gateway National Seashore and administered by the National Park Service. The paper includes many references made to human disturbance of loons, gulls, cormorants, and herons. Disturbances were tallied for aircraft, and for people walking, digging worms, riding horseback, jogging, and working. Ducks and brants (*Branta bernicla*) usually went to the water when disturbed on land and often were not disturbed when on the water. Birds generally did not respond to subsonic jets, but always responded to the supersonic transport jets by flushing. Many birds returned to where they had been.

29. BURTON, R. A., AND R. J. HUDSON. 1975. Activity budgets of lesser snow geese wintering on the Fraser River Estuary, British Columbia. Wildfowl 29:111–117.

    Disturbance and changes in food availability may alter the feeding routine of snow geese (*Chen caerulescens*). One critical factor is the efficiency of feeding in relation to the amount of available time. Disturbed and undisturbed, time in flight was at least 0.25 h per day. However, during periods of excessive wind or harassment, this level increased up to threefold. Flight was 1.0% of all time spent in major activities. Nocturnal feeding occurred not only during the hunting season. Fluctuating food availability because of changing tide levels influenced nocturnal feeding more than harassment by hunters. The early autumn migrants invariably first settled at Brunswick Point in October. This marsh was used day and night for a short time, but hunting pressure during the day soon forced the snow geese onto the Reifel Refuge. The availability of food at Brunswick Point apparently caused them to return each night.

30. CAMPBELL, L. H. 1978. Patterns of distribution and behavior of flocks of seaducks wintering at Leith and Musselburgh, Scotland. Biological Conservation 14:111–124.

    During 1972–73, while the retaining walls for land reclamation at the new sewage works were under construction, considerable activity on the shore affected greater scaup (*Aythya marila*), common goldeneye (*Bucephala clangula*), and common eiders (*Somateria mollissima*) between Leith and Seafield sewers. Observed change in distribution pattern was a short-term response to localized increases in disturbance levels.

31. CAMPBELL, L. H., AND H. MILNE. 1977. Goldeneye feeding close to sewer outfalls in winter. Wildfowl 28:81–85.

    Common goldeneyes (*Bucephala clangula*) were obviously sensitive to sudden loud noises. On 11 occasions (for example, blasting or ship sirens), the ducks immediately took flight and left the bay. Usually ducks returned to the bay within 10 min of a disturbance, but on 6 days, no birds returned after 2 h and fewer than 10 of the original flock returned on the remaining 5 days. Large vessels anchored in the bay did not disturb the ducks, whereas smaller boats approaching the flock caused the birds to take flight, usually to the southern part of the bay, from where they gradually returned when the boat had departed. Regular disturbance to birds in the sewer was caused by passers-by on the sea-wall. When approaching from the east, people were visible some distance from the flock, which merely swam farther offshore. However, from the west, passers-by tended to come into view suddenly close to the sewer, and the birds usually took flight.

32. CAMPREDON, P. 1981. Hivernage du canard siffleur *Anas penelope* L. en Camargue (France) stationnements et activités (Wintering of the widgeon [*Anas penelope* L.] in the Camargue region of [France] wintering grounds and their activities). Alauda 49:161–193.

Eurasian wigeons (*Anas penelope*) were disturbed by natural predators 361 times (82.7%), by people 19 (3.4%), by planes 19 (3.4%), and by unknown causes 58 times (10.4%). A greater percentage of a flock was disturbed by people (61.5%) and by planes (49.6%) than by other types of disturbances. Time spent in flight per disturbance by predators varied from 8 sec to 58 sec whereas disturbances by people lasted 34 sec, and by airplanes, 9 sec. Disturbances by people were chiefly by hunters, anglers, and pilots of aircraft—especially helicopters at low altitude. People disturbed the ducks during the day, and avian predators mostly at night. Predators caused localized displacements, but people on a small body of water caused total evacuation. If the disturbance occurred on a larger body of water, ducks regrouped in the middle. Ducks were very sensitive to anglers who went into the water. Human disturbances modified the periodicity of ducks' activities and seriously curtailed feeding.

33. CATCHPOLE, C. K., AND C. F. TYDEMAN. 1975. Gravel pits as new wetland habitats for the conservation of breeding bird communities. Biological Conservation 8:47–59.

The mallard (*Anas platyrhynchos*) comprised 8.0% and the tufted duck (*Aythya fuligula*) 2.4% of the total breeding population in 10 sites. Reclamation, pollution, and recreation are obvious threats to nesting waterfowl. As the demand for water-based recreation continues to increase, gravel pits will probably be disturbed more than natural wetlands.

34. CHOATE, J. S. 1966. Breeding biology of the American eider (*Somateria mollissima dresseri*) in Penobscot Bay, Maine. M.S. thesis, University of Maine, Orono. 173 pp.

Nesting success of common eiders (*Somateria mollissima*) on a study area visited daily by Milne (1963) was compared with a relatively undisturbed control area. Nesting success of common eiders was somewhat lower (3%) in the disturbed area. However, nesting success during this study was significantly lower in areas that were frequently visited.

35. CHOATE, J. S. 1967. Factors influencing nesting success of eiders in Penobscot Bay, Maine. Journal of Wildlife Management 31:769–777.

Human disturbance was indirectly responsible for lowered nesting success. Observations from a blind revealed that after an investigator left an island, herring gulls (*Larus argentatus*) and great black-backed gulls (*L. marinus*) returned to their nests much sooner than common eiders (*Somateria mollissima*). Before common eiders returned, nests were highly vulnerable to predation by gulls. When the island was revisited one or more times on the same day, after setting nets or banding common eiders, many newly destroyed nests were evident. Gulls flew back to the island as soon as workers left and probably destroyed many nests before the common eiders returned. Human disturbance did not seem to directly cause many desertions of nests. A few clutches apparently were lost because of overexposure to heat when nests were visited by the investigator on hot, sunny days. Overheating occurred when many common eiders were flushed from their nests for 2 h or more. Goose Island, which was disturbed twice as often as East Goose Rock, had 27% nesting success—about two-thirds (40%) that of eiders on East Goose Rock ($P < 0.01$).

36. COMBS, D. L. 1987. Ecology of male mallards during winter in the Upper Mississippi alluvial valley. Ph.D. thesis, University of Missouri, Columbia. 223 pp.

Hunting was probably the primary cause of habitat shifts during early winter from Unit A and greentree reservoirs on the Duck Creek Wildlife Management Area to areas not hunted on the Mingo National Wildlife Refuge. During all 3 years of this study, mallards (*Anas platyrhynchos*) used Unit A extensively before and after waterfowl hunting season but little during the season. Non-hunting disturbance (e.g., vehicular traffic) may have also influenced the distribution of mallards in the Mingo Swamp and warrants additional research. Lack of hunting probably reduced vigilance during early spring, and habitat shifts to unhunted areas on the Mingo National Wildlife Refuge may have influenced a midwinter decline in vigilance during 1985–86. Alert behavior was also greater in shallow habitats than in open water zones where disturbance was minimal because of distance from roads.

37. COOCH, F. G. 1958. The breeding biology and management of the blue goose (*Chen caerulescens*). Ph.D. thesis, Cornell University, Ithaca. 235 pp.

The fear of dogs by geese was amply demonstrated at Boas River in 1953 when snow geese ran wildly across the tundra pursued by a stray dog. The reaction of snow geese toward intrusion by humans is variable, but seems density dependent. Development of tameness was noticed at the Boas River, where managers took the same route each day and always approached nests from the same direction. If managers approached nests from a different direction, the birds moved away when the investigator was within 45.7 m of the nest, while in the second case birds flushed at no more than 6.1 m. Females followed a definite ritual when returning to the nest, after turning eggs; or when disturbed by predators or low-flying aircraft. When dense colonies of nesting geese suddenly became reduced to a few scattered incubating pairs, remaining females and dry young frequently deserted nests, leaving the young that were not yet dry. When geese were disturbed by humans when one gosling was strong enough to follow the adults, the rest of the brood was left to its fate.

38. COOCH, F. G. 1965. The breeding biology and management of the northern eider (*Somateria mollissima borealis*) in the Cape Dorset area, Northwest Territories. Canadian Wildlife Service Wildlife Management Bulletin Series 2(10). 68 pp.

Frequent flushing of birds in the study area and subsequent exposure of eggs to predators seemed to raise normal loss of eggs for the common eider. The birds on the study area seemed to be tamer in 1956 than in 1955. Because of greater tameness, the birds returned to their nests more quickly or were less prone to desert nests upon disturbance and thus reduced predation. Some desertion was attributed to the presence of people in the nesting area.

39. COOKE, A. S. 1987. Disturbance by anglers of birds at Grafham Water. ITE Symposium 19:15–22.

Grafham Water in Cambridgeshire is one of the most important wintering sites for waterfowl in Britain. Sailing there has relatively little effect on waterfowl because it is only intermittent and disturbance is more or less confined to deep water that most waterfowl avoid. However, anglers on the bank and in boats arrive in large numbers on every day during the angling season, and often fish the shallow, sheltered bays and creeks that birds favor. Detailed observations and results are presented for effects of angling on numbers and distribution of waterfowl, grebes (*Podiceps* and *Tachybaptus*), and Eurasian coots (*Fulica atra*); for an increase of waterfowl at the conclusion of the angling season; for effects of the close of angling on distribution of wildfowl species; for tolerance distance by mallards (*Anas platyrhynchos*) in specific areas in relation to disturbance and changes after the angling season; for comparative approachability of water birds by area of the reservoir; and for overall ranking of vulnerability of species based on bird counts and controlled approach studies. Ranking for Grafham may not be applicable elsewhere.

40. COOPER, J. A. 1978. The history and breeding biology of the Canada geese of Marshy Point, Manitoba. Wildlife Monograph 61, The Wildlife Society, Washington, D.C. 87 pp.

During this study, 2,889 visits were made to 578 nests (first, continuation, and renests); the average disturbance by observer per nest was five. Only one desertion during the study was believed to have been caused by an investigator. This is in contrast to findings of others who cited disturbance by observers as cause of nest abandonment by Canada geese (*Branta canadensis*): Martin (1964) who concluded that his investigation contributed to 40% of the total nest losses at Ogden Bay, Utah; Dow (1943) who attributed 23% of the nest destruction in his study at Honey Lake, California, to human activities; and, in a more recent study, Hanson and Eberhardt (1971) found that Canada geese in Hanford, Washington, deserted nests visited most often at a higher rate (12 of 16 nests) than least visited (3 of 7 nests, $P > 0.05$). Conversely, Geis (1956), working with Canada geese in Montana, concluded that disturbance by the investigator was not an important cause of desertion. Similarly, Weigand et al. (1968), who made daily visits to nests of captive geese in Michigan, attributed no losses of nests to human disturbance.

41. COULTER, M. W., AND W. R. MILLER. 1968. Nesting biology of black ducks and mallards in northern New England. Bulletin 68-2, Vermont Fish and Game Department, Montpelier. 73 pp.

Tolerance by waterfowl to disturbance varied by individual. Hens occasionally deserted their clutches after the first disturbance, but only one of 30 trapped hens deserted her nest. Trapping of hens was attempted at 291 nests and 223 (80%) hens were captured. Desertion of nests after a trap was set was 6% in ring-necked ducks (*Aythya collaris*), 9% in American black ducks (*Anas rubripes*) and 26% in mallards (*A. platyrhynchos*). Ten of 18 desertions were in a group of especially intolerant mallards on Dameas Island. Certain other mallards were more tolerant and only 16% of 49 deserted nests at other islands. Abandonment of nests was not as common during the last week of incubation. Human activity on islands is detrimental to waterfowl production; the presence of people discourages nesting. Chances for avian predation were increased because some potential avian predators returned to the islands sooner than most ducks; flushed hens usually left nests uncovered; and flushing of hens often resulted in pieces of down scattered on surrounding vegetation. In certain instances, dispersal of broods by disturbances caused mortality of ducklings.

42. CRAIGHEAD, J. J., AND D. S. STOCKSTAD. 1961. Evaluating the use of aerial nesting platforms by Canada geese. Journal of Wildlife Management 25:363-372.

The exposed position of many nest boxes seemed to invite greater desertion, but the added security of an elevated site greatly reduced predation. Much desertion by Canada Geese (*Branta canadensis*) was attributed to the disruptive influence of anglers and sightseers who frequently came close to exposed nesting platforms in Flathead Lake or who occasionally inspected nest boxes at close range. Human interference could be reduced by selecting more secluded sites for nest boxes.

43. CRAVEN, S., AND J. ELLIS. 1982. Assessment of techniques used in a 5-year program of Canada goose dispersal. Page 56 *in* M. A. Johnson, editor. Transactions of the Canada goose symposium, 28-29 April 1982, Bismarck, N. Dak. The Wildlife Society, North Dakota Chapter and Central Mountains and Plains Section.

Depredation and other problems associated with a large concentration of Canada geese (*Branta canadensis*) at the Horicon National Wildlife Refuge prompted state and federal wildlife agencies to attempt a 50% reduction of the goose flock during 1976-80. Cultivated foods were removed from the refuge, and water and sanctuary were reduced. Initially, denial of sanctuary was identified as the critical component of successful reduction of flock size. Thus, disturbance or hazing by airboats, propane exploders, and a combination of the two were the primary techniques to disperse the flock. Observations of Canada geese neckbanded at the refuge suggested a movement of some birds to wintering areas in Illinois during October when, in the absence of disturbance, the birds would probably have remained in Wisconsin. Increased mortality from a near doubling of the harvest quota (28-50 thousand) from 1976-78 also seems to have contributed to the reduction of geese.

44. CRONAN, J. M., JR. 1957. Food and feeding habits of the scaups in Connecticut waters. Auk 74:459–468.

Human activity had a strong effect on feeding lesser scaup (*Aythya affinis*). During the hunting season, lesser scaups foraged less in areas that were heavily hunted. During the fall and spring, not many lesser scaups foraged where people were angling or boating. Even during mid-winter, when a comparatively balmy Saturday or Sunday encouraged human activity along the shore, the lesser scaups were not present on their usual foraging grounds.

45. DAVIS, R. A., AND A. N. WISELEY. 1974. Normal behavior of snow geese on the Yukon-Alaska North Slope and the effects of aircraft-induced disturbance on this behavior, September, 1973. Chapter II *in* W. W. H. Gunn, W. J. Richardson, R. E. Schweinburg, and T. D. Wright, editors. Studies on snow geese and waterfowl in the Northwest Territories, Yukon Territory, and Alaska, 1973. Arctic Gas Biological Report 27.

Up to 400,000 snow geese (*Chen caerulescens*) congregate on the North Slope to accumulate energy for fall migration. The authors documented undisturbed behavior and evaluated effects of overflights by aircraft on 175 flocks of snow geese observed at five camps along the North Slope. During 663 h, geese experienced 73 natural disturbances and 163 non-experimental overflights by aircraft. Experimental overflights at 2.5-h intervals with a Cessna 185 and a Bell 206-B helicopter were also made. Undisturbed snow geese spent 57% of daylight hours feeding (juveniles, 65–70%). Fixed-wing aircraft and helicopters flushed snow geese with equal frequency, but helicopters flushed geese at greater distances and fixed-wing aircraft elicited longer flights from geese. Snow geese responded variably to increased frequencies of overflights by aircraft. Non-experimental disturbances by aircraft averaged one per four daylight hours and decreased the geese's time spent feeding by 2.6%. Experimental overflights at 2-h intervals by fixed-wing aircraft decreased feeding time and could cause a reduction of 20.4% in energy reserves for juveniles; a helicopter decreased feeding time 9.5%.

46. DENNIS, D. G., AND R. E. CHANDLER. 1974. Waterfowl use of the Ontario shorelines of the southern Great Lakes during migration. Pages 58–65 *in* H. Boyd, editor. Canadian Wildlife Service studies in eastern Canada, 1969–73. Canadian Wildlife Service Report 29.

Boat traffic is low in several bays and large numbers of diving ducks are able to feed undisturbed. Baited sanctuaries throughout the marshes increase the carrying capacity for dabbling ducks (*Anas*) and Canada geese (*Branta canadensis*). Many redheads (*Aythya americana*) and canvasbacks (*A. valisineria*) are present during spring and autumn in one section of the Detroit River near the mouth of the Canard River, which has limited boat traffic. Although marsh habitat seems to be of fair quality, human disturbance and absence of suitable sanctuaries cause lower use by waterfowl than expected. Some dabbling ducks use the area less during autumn because of power boat traffic. Although humans disturb diving ducks during autumn too, the birds can rest on the open waters of Lake Erie during times of peak disturbance on the bay. Dabbling duck habitat is of low quality, except in the Grand River marshes, where heavy hunting pressure and lack of suitable sanctuaries cause most of the dabbling ducks to leave shortly after opening day of the hunting season.

47. DENNIS, D. G., G. B. MCCULLOUGH, N. R. NORTH, AND R. K. ROSS. 1984. An updated assessment of migrant waterfowl use of the Ontario shorelines of the southern Great Lakes. Pages 37–42 *in* S. G. Curtis, D. G. Dennis, and H. Boyd, editors. Waterfowl studies in Ontario, 1973–81. Occasional Paper 54, Canadian Wildlife Service.

Limited waterfowl use during both spring and autumn is due to scarcity of aquatic vegetation, although disturbance by pleasure craft also contributes. Populations of mallards (*Anas platyrhynchos*) and Canada geese (*Branta canadensis*) increased chiefly from more use of legal baiting by hunting clubs. Establishment of the St. Clair National Wildlife Area in 1974 increased use by American black duck (*A. rubripes*). Use by redheads (*Aythya americana*), canvasbacks (*A. valisineria*), and common mergansers (*Mergus merganser*) increased much during spring and autumn as a result of extensive disturbance by boat traffic in the better habitat along the east shore of Lake St. Clair. Although increased ship traffic in the Outer Bay because of the Nanticoke Industrial Development will not greatly disturb waterfowl, increased potential for an oil spill exists for large portions of the continental populations of canvasbacks and redheads. Shooting pressure forces most birds to leave shortly after opening of the hunting season. Lesser scaups (*A. affinis*) are moderately disturbed by increased power boat traffic.

48. DENNIS, D. G., AND N. R. NORTH. 1984. Waterfowl use of the Lake St. Clair marshes during migration in 1968–69, 1976–77, and 1982. Pages 43–52 *in* S. G. Curtis, D. G. Dennis, and H. Boyd, editors. Waterfowl studies in Ontario, 1973–81. Canadian Wildlife Service Occasional Paper 54.

Larger local populations of mallards (*Anas platyrhynchos*) and Canada geese (*Branta canadensis*), more baited sanctuaries, more food plants from higher lake levels, and a national wildlife area closed to hunting increased use of the Lake St. Clair marshes by waterfowl. Destruction of habitat from agricultural drainage, increased boat traffic from a new marina in wetlands, increased public hunting on areas that had previously been hunted at a low intensity, and declining populations of American black ducks (*A. rubripes*) and ruddy ducks (*Oxyura jamaicensis*) reduced waterfowl use of the area.

49. DENSON, E. P., JR. 1964. Comparison of waterfowl hunting techniques at Humboldt Bay, California. Journal of Wildlife Management 28:103–120.

The behavior of birds hunted by scullers differed radically from day to day. Sometimes nearer ducks leapfrogged no more than 188.2 m (200 yards), whereas at other times, entire flocks rose and moved for 1.6 km or more. Scullers disturbed birds and made them more difficult to approach, but movement of flocks of brants (*Branta bernicla*) by scullers were temporary and probably benefitted shooters in open-water and shore blinds. Waterfowl suffered far more harassment from amateur crab fishermen and pleasure boaters with high-powered outboard motors. Daily pressure by hunters on the spit and the harassment by boaters are chiefly responsible for eliminating the brant population, which once spent November and December on Humboldt Bay. A sector of the bay should be closed to boats from October through April, when large numbers of waterfowl are present. An area of 81–121.5 ha (200–300 acres), less than 10% of the bay, should protect the birds.

50. DENSON, E. P., JR., AND S. L. MURRELL. 1962. Black brant populations of Humboldt Bay, California. Journal of Wildlife Management 26:257–262.

Few bays along the Pacific Coast of the contiguous states escaped commercial or recreational development. In most cases this process greatly reduced the value of bays to waterfowl. Intensive recreational and industrial uses are rapidly depriving brants (*Branta bernicla*) of food and shelter on California bays. So few birds are present prior to January and February that starting the hunting season one or more months before the first of January has little effect on overall harvest. However, hunters concentrate on geese that arrive early in the season and, at times, drive these small flocks from the bay.

51. DILLON, S. T. 1956. A nine-year study of fall waterfowl migration on University Bay, Madison, Wisconsin; Part 1. Transactions of the Wisconsin Academy of Science, Arts and Letters 45:31–57.

Fishing influences the use of the bay by waterfowl. This sport is extremely popular during the fall and the passage of boats through the bay is often a source of considerable disturbance. On very calm days all species of waterfowl present tend to gather on the open waters of the lake. This may reflect a preference on their part or may be the result of disturbance by the generally increased boat traffic.

52. DOW, J. S. 1943. A study of nesting Canada geese in Honey Lake Valley, California. California Fish and Game 29:3–18.

On 27 March 1939, a Canada goose (*Branta canadensis*) nest with six eggs was found on top of a haystack. On 20 April, the incubating bird was disturbed by photographers and left the nest for about 2 h during the heat of the day. The goose continued to incubate until 22 June when the eggs were taken, examined and found to contain dead embryos after at least 87 days of incubation. On 18 March 1940, a goose nest with two eggs was found on the top of one end of a large haystack, more than 15.5 m (18 feet) from the ground. Two or more wagon loads of hay were taken from the opposite end of the stack each day. A last visit to the nest revealed that the goose hatched two goslings in spite of the fact that she had been disturbed each day during incubation. Overall, six desertions were directly traced to human activities. The disturbances of irrigators traveling the canal banks with their dogs were responsible for five. One nest was deserted when the author flushed an incubating goose from her nest while two crows were circling overhead. Although the eggs were carefully covered, the goose never returned.

53. DUEBBERT, H. F., AND J. T. LOKEMOEN. 1980. High duck nesting success in a predator-reduced environment. Journal of Wildlife Management 44:428–437.

Abandonment rates were low: 21 of 1,062 nests (2%) were abandoned during all years. Nearly all abandonments were the result of interference by the researcher when nests contained one to five eggs. Another 31 nests had other fates. Four were destroyed by vehicles of the researchers.

54. DWERNYCHUK, L. W., AND D. A. BOAG. 1972. How vegetative cover protects duck nests from egg-eating birds. Journal of Wildlife Management 36:955–958.

To simulate the condition of waterfowl nests during the laying period, the authors followed the history of 128 artificial nests that varied in visibility. Among these nests, success in avoiding egg loss to birds directly correlated with the presence of overhead cover. However, even among nests that were completely screened by vegetation, 34% were lost. The authors concluded that egg-eating birds were reacting to other visual cues such as disturbed vegetation or nest markers left at and around the nests. Disturbed vegetation is much more likely to be the visual cue for predatory birds, because, in spite of all efforts to the contrary, approaching and leaving nest sites was impossible without disturbing some vegetation, particularly in dense vegetation.

55. DZUBIN, A., AND J. B. GOLLOP. 1972. Aspects of mallard breeding ecology in Canadian parkland and grassland. Pages 113–152 *in* Population ecology of migratory birds, papers from a symposium held at the Migratory Bird Population Station, Laurel, Maryland, 9–10 October 1969. U.S. Department of Interior, Fish and Wildlife Service Wildlife Research Report 2.

The authors believed that wild mallards (*Anas platyrhynchos*) breeding under natural conditions are poor subjects on which to accumulate statistically sound population parameters. They believed this species is particularly sensitive to human interference, especially during brood rearing.

56. EARL, J. P. 1950. Production of mallards on irrigated land in the Sacramento Valley, California. Journal of Wildlife Management 14:332–342.

Some desertions by mallards (*Anas platyrhynchos*) could have been caused by too frequent interference by the observer. Early in the nesting period, nests were visited every other day. The time between later visits was extended to a week. The only other large loss by predation was in the wheat. The author believes that losses were due in part to trails made by himself in the process of visiting the nests. The author did not believe that predators, starting at random at the edge of a large wheat field, accounted for almost a third of the nests without being led to the nests by an investigator.

57. EBERHART, L. E., R. G. ANTHONY, AND W. H. RICKARD. 1989. Movement and habitat use by Great Basin Canada goose broods. Journal of Wildlife Management 53:740–748.

Broods of Canada geese (*Branta canadensis*) seemed to be most susceptible to human disturbance during the first few weeks after hatching, but older broods were relatively tolerant of repeated human disturbance. Eight broods in their home ranges in the lower stretch of the river had access to shoreline areas that were adjacent to human habitation. These broods showed a significant avoidance of human habitation ($P = 0.02$) and concentrated in portions of their home ranges that were comparatively free from human disturbance.

58. EDINGTON, J. M. 1980. Recreation and wildlife. Nature in Wales Newsletter 3:10–16.

Edington reviews wildlife-based (bird-watching, angling, and shooting), aesthetic (scenic), and active recreation (climbing, caving, skiing, and sailing). He discusses disturbances of overwintering waterfowl from overzealous bird-watchers, observation blinds, protective legislation, shooting, lead shot, angler's weights, discarded nylon lines, predator control, trampled vegetation, and sailing.

59. EDWARDS, R., AND D. BELL. 1985. Fishing in troubled waters. New Science 1446, 7 March:19–21.

At the Llandegfedd reservoir in the Usk Valley, where the angling season has recently been advanced by 2 weeks to 20 March, anglers choose parts of the reservoir that birds such as green-winged teals (*Anas crecca*) and Eurasian wigeons (*A. penelope*) also prefer. The reservoir is an important trout fishery, but also supports the highest number of overwintering waterfowl in South Wales. As a result of the anglers' intrusion, these birds gathered in the center of the reservoir during the day, away from the shallow areas and shore where they would normally feed on grasses and herbs. Birds dispersed from the site after a few days, possibly because of increased sailing activity in central areas. The number of Eurasian wigeons, for example, fell from over 400 to about 60 within a week. This contrasted with a much more gradual emigration from a nearby undisturbed site at Slimbridge on the Severn Estuary.

60. EDWARDS, R. W., AND D. V. BELL. 1987. The impact of angling on wildlife. Pages 161–166 *in* Proceedings of the 4th British Freshwater Fisheries Conference, 1–3 April 1985, University of Liverpool.

Recreational activities such as boating and angling disturb some bird species. Protection of wildlife requires wider use of refuges and temporal restrictions on recreational activities at critical stages of overwintering and breeding. Interference of breeding birds, which nest along the margins of water bodies, by angling and other activities, needs further investigation.

61. EINARSEN, A. S. 1965. Black brant, sea goose of the Pacific coast. University of Washington Press, Seattle. 142 pp.

An airplane at 1 or 2 miles may cause either single or flocked brants (*Branta bernicla*) to take to the air. In some areas, boating continually molests foraging birds. During the last 5 years, high-speed boats are common from British Columbia to San Quintin Bay in northern Baja California. The use of power dredges intimidates foraging birds in daylight and tends to destroy eelgrass beds. A disturbance was observed on Mission Bay, San Diego Harbor, on 19 January 1958. Here at low tide the brant geese find sanctuary only in small elbows off the main channel in the bay, where they could drift up a mud-bottomed slough for perhaps a few hundred yards (a few hundred meters); but the continual traffic of high-speed boats, traveling at 12.9–64.4 kph (8–40 mph), kept the birds from foraging on eelgrass beds or occupying open water in the channel. Boating on Humboldt Bay, California, is also forcing brants to spend nights on the ocean. The losses are profound. Sleeping brants drift unconsciously into the breakers where the heavy sand content beats them down to the ocean floor. They wash ashore dead.

62. EISENHAUER, D. I., AND C. M. KIRKPATRICK. 1977. Ecology of the emperor goose in Alaska. Wildlife Monograph 57, The Wildlife Society, Washington, D.C. 62 pp.

    Emperor geese (*Chen canagica*) had the highest rate of nesting success because they were more reluctant than other species to leave their nests when the authors were in the area. For 3 years, destruction of nests by natives amounted to 34% of the total number of unsuccessful clutches by emperor geese and brants (*Branta bernicla*) on the study area and 37% of the total losses of nests from predation. The authors expect egg collection from these birds to continue in Alaska. Increased human disturbance in 1972 corresponded to increased desertions of nests by birds and increased predation of their eggs in 1972. Human-induced desertion of all eggs was 0 in 1971, 4.4% in 1972, 0.9% in 1973, and 1.9% overall. About 57% of all emperor goose eggs lost on the study area were from nests classified as successful; investigator disturbance contributed to predation on eggs. Human disturbances undoubtedly caused significant brood mortality because humans frequently caused broods to break up and scatter or frightened parents to run ahead of their goslings. Banding operations can increase the predation of glaucous gulls (*Larus hyperboreus*) on young waterfowl.

63. ELLIG, L. J. 1955. Waterfowl relationships to Greenfields Lake, Teton County, Montana. Montana Fish and Game Department Technical Bulletin 1. 35 pp.

    Human interference is thought to have caused the desertion of three nests with one egg each and five with complete clutches. Sixteen deserted inactive nests or nest forms of five species with one to nine eggs each were found, suggesting that females not uncommonly abandon uncompleted nests without human interference. Six nests were deserted for unknown reasons. Human intrusion is not believed to have increased vulnerability of clutches to predation by striped skunks (*Mephitis mephitis*).

64. ELY, C. R., AND D. G. RAVELING. 1984. Breeding biology of Pacific white-fronted geese. Journal of Wildlife Management 48:823–837.

    Greater white-fronted geese (*Anser albifrons*) deserted 2 of 102 nests; only one desertion was human-induced.

65. EVANS, C. D., AND K. E. BLACK. 1956. Duck production studies on the prairie potholes of South Dakota. U.S. Fish and Wildlife Service Special Scientific Report—Wildlife 32. 59 pp.

    Human disturbances such as brood surveys do not diminish use of wetlands except for the occasional brood driven ashore during the actual beatout. The authors believed that even when broods are driven ashore, they probably return once the activity subsides.

66. EVANS, C. D., A. S. HAWKINS, AND W. H. MARSHALL. 1952. Movements of waterfowl broods in Manitoba. U.S. Fish and Wildlife Service Special Scientific Report—Wildlife 16. 47 pp.

    Human intrusion influenced brood movement in some instances, but often had little effect. Some broods could not be driven from their potholes.

67. EVANS, R. D., AND C. W. WOLFE, JR. 1967. Waterfowl production in the Rainwater Basin area of Nebraska. Journal of Wildlife Management 31:788–794.

    Miscellaneous causes of nest failure included human disturbance, flooding, and burning. Three nests of blue-winged teals (*Anas discors*) were abandoned because of humans.

68. EVENSON, D., C. HOPKINS, AND G. MARTZ. 1974. Waterfowl and waterfowl hunting at Houghton Lake. Michigan Department of Natural Resources, Wildlife Division, Information Circular 171, Lansing. 7 pp.

    Disturbances of waterfowl on Houghton Lake during early fall and the hunting season of 1972 were caused by at least six different sources including boats, anglers, hunters, this study, aircraft, and a bald eagle (*Haliaeetus leucocephalus*). At least 85% of the disturbances were by boats and 53% by hunters. More ducks are disturbed by hunting than other disturbances, primarily because more ducks are on the lake during the hunting season. During the hunting season of 1972, an estimated 408,000 waterfowl were disturbed on the lake. Individual birds were disturbed more than once per day. When the number of birds disturbed is compared with the duck-use days for the season (408,000:268,000), each duck and each American coot (*Fulica americana*) was disturbed an average of 1.5 times per day. Disturbance rates were about 1.5 times greater on weekends than during the week. However, in 1972, ducks were never drive off the lake because of harassment.

69. EVENSON, D. E. 1974. Migratory waterfowl use of Houghton Lake, Michigan. M.S. thesis, University of Michigan, Ann Arbor. 105 pp.

Disturbances from occupied hunting blinds and boats caused birds to seek refuge on open waters during the day and were more significant in keeping ducks from the middle grounds than from any other location on the lake. In pre-season counts, ducks on the middle grounds were 20.7% of duck-use days. After hunting started, only 7.4% of the duck-use days were on the middle grounds. (See the preceding and following papers, which seem to be based on this thesis.)

70. EVENSON, D. E., AND C. X. HOPKINS, JR. 1973. Waterfowl at Houghton Lake: including an analysis of the influence of food resources and disturbances on waterfowl use. Technical Bulletin 73-3, Michigan Department of Natural Resources, Lansing. 69 pp.

The largest disturbances in 1972 with an average of 1,502 birds were caused by hunters with blinds on their boats. The second largest disturbance factor was the authors' observations. The value of 372 birds per disturbance is probably out of proportion to the actual effect of disturbance on the lake because all disturbances by the authors were tallied. Hunters who used floating blinds were the most numerous type of hunters on the lake and caused an average disturbance of 232 birds. Non-hunting disturbance caused fewer and smaller disturbances than hunters during the hunting season. However, before the opening of the hunting season, anglers created five disturbances with an average of 537 birds per disturbance.

71. FIGLEY, W. K., AND L. W. VANDRUFF. 1982. The ecology of urban mallards. Wildlife Monograph 81, The Wildlife Society, Washington, D.C. 40 pp.

During January–March, many mallards (*Anas platyrhynchos*) were wary of humans and often flew up 60 m in advance of an approaching boat. They were reluctant to take food from people. During the rest of the year, ducks in the lagoon were much less apprehensive and paid little attention to moving boats. Increased wariness during winter may be due to an increased number of wild migrant birds in the Angelholm flock. One of seven factors contributing to severe brood losses in the lagoon was the capturing and scattering of broods by people. Cats and dogs destroyed 28 mallard ducklings on a small campus pond in 1974, and 13 in 1975.

72. FRASER, M. W. 1987. Reactions of sea-ducks to windsurfers. British Birds 80:424.

On 22 June 1981, the author was watching a flock of 400 common eiders (*Somateria mollissima*) about 200 m from shore and about 220 black scoters (*Melanitta nigra*) 400 m from shore. Suddenly the common eiders took off eastward to the open sea and a few seconds later, the black scoters followed them. The author then noticed that a windsurfer had come into view from around a rocky headland 500 m to the west and 250 m from the shore. Ten min after he had disappeared, the common eiders returned, but not the black scoters. In contrast to the sail and engine-powered dinghies and small boats, the appearance of the windsurfer created instant flight by the birds. The editor of this journal article added a footnote in which he suggested that based on his observations on the Ythan Estuary, Grampian, ducks, mainly common eiders, long-tailed ducks (*Clangula hyemalis*), red-breasted mergansers (*Mergus serrator*), common goldeneyes

(*Bucephala clangula*) and Eurasian wigeons (*Anas penelope*), became acclimated to wind surfers and therefore did not react as severely to them as reported by the author.

73. FREDERICK, R. B., W. R. CLARK, AND E. E. KLAAS. 1987. Behavior, energetics, and management of refuging waterfowl: a simulation model. Wildlife Monograph 96, The Wildlife Society, Washington, D.C. 35 pp.

A stochastic simulation model designed to test alternative management schemes on refuging waterfowl populations was constructed from data on fall-migrating snow geese (*Chen caerulescens*) at the DeSoto National Wildlife Refuge. Components of the model include population level, food density and distribution, foraging flight characteristics, feeding rates, activity and energy budgets, migration rates, and effects of weather, hunting pressure, and land management practices on the system. Data were collected to test the model's validity. Refuge population level was not sensitive to shifts (±20%) in the input values of 25 selected parameters, but hunting mortality and daily foraging distances were sensitive to several combinations of parameter perturbations. Model outcome was most sensitive to changes in digestive efficiency, mean food density, and the proportion of refuge fields in which food was available. In other experiments with the model, increased hunting pressure caused significantly ($P < 0.05$) increased hunting mortality and reduced the refuge population. The effect of hunting was less important in reducing waterfowl population size than the associated disturbance of feeding snow geese by hunters.

74. FREDRICKSON, L. H., AND R. D. DROBNEY. 1979. Habitat utilization by postbreeding waterfowl. Pages 119–131 *in* T. A. Bookhout, editor. Waterfowl and wetlands—an integrated review. North Central Section, The Wildlife Society, La Crosse Printing Co., La Crosse, Wisconsin.

Reduced caloric intake can profoundly increase the time for waterfowl to replenish fat reserves. Reducing the daily caloric intake by 19% (390 kcal per day) more than doubles the estimated time required for fat replenishment, but these estimates represent a simplified case and actual requirements may be different. Concentrating waterfowl creates two problems that could adversely affect their energy budgets. First, food supplies become depleted more rapidly. Decreased food availability necessitates increased foraging time or longer foraging flights for species that forage in fields. Secondly, hunting pressure tends to increase in areas where waterfowl concentrate. Harassment by hunters could increase movements and reduce time for foraging.

75. FREDRICKSON, L. H., AND F. A. REID. 1988. Waterfowl use of wetland complexes. Pages 1–6 *in* Managing waterfowl habitats: breeding, migrating, wintering. Gaylord Memorial Laboratory, University of Missouri, Puxico, Missouri; U.S. Fish and Wildlife Service, Office of Information Transfer, Fort Collins, Colo.

Refuge management may require manipulation of soil and water to produce habitat structure or essential foods. Production of foods does not assure their use by waterfowl. Foods are accessible only if appropriate water depths are maintained during critical time periods, habitats are protected from disturbance, and habitats that provide protein and energy are close together. Disturbance is particularly important, and recognition of the influence of disturbance on access to and acquisition of needs throughout the annual cycle is essential. Subtle disturbances by bird watchers, researchers, and refuge activities during critical biological events may be as detrimental to waterfowl populations as hunting or other water-related recreation such as boating. At certain locations, predators or activities associated with barge traffic, oil exploration, or other industrial or military operations are detrimental to waterfowl.

76. FRUZINSKI, B. 1977. Feeding habits of pink-footed geese (*Anser fabalis brachyrhynchus*) in Denmark during the spring passage in April 1975. Danish Review of Game Biology 10:1–11.

Because of the very narrow isthmus between the North Sea and the Nissum fjord and the considerable disturbance there by humans and vehicles, the geese often fed outside the area during daytime. While feeding in the Fiilso area, the pink-footed geese were very sensitive to disturbance, (e.g., by farmers and vehicles). The tolerance distance was about 300 m, and rarely 200 m during windy and rainy days. Geese usually fed and rested in the middle of the fields, far from roads, where they were most secure. Often disturbed at midday, they moved to the edges of the area into grassland where no farm work was being done.

77. GAUTHIER, G., J. BÉDARD, AND Y. BÉDARD. 1984. Comparison of daily energy expenditure of greater snow geese between two habitats. Canadian Journal of Zoology 62:1304–1307.

Snow geese (*Chen caerulescens*) seemed to fly only when necessary and flew mostly when disturbed or between the marsh and adjacent farmland to feed. These flights were of short duration.

78. GEIS, M. B. 1956. Productivity of Canada geese in the Flathead Valley, Montana. Journal of Wildlife Management 20:409–419.

Disturbance by the investigators was not assumed to be an important cause of desertion because visits were short and the Canada geese (*Branta canadensis*) were not kept away from the nest long enough to cause chilling of the eggs. Human disturbance over extended periods apparently increased the desertion rate. This was indicated on two islands in the lake where people were living during part of one nesting season. Once, six of eight nests were deserted and then six of nine nests were deserted. In years of no human disturbance, nesting success was above average on these two islands.

79. GILBERT, B. 1977. Uncle Sam says SCRAM! Audubon 79:42–55.

The objective was to make the Horicon National Wildlife Refuge less attractive to Canada geese (*Branta canadensis*). To accomplish this, acreage for growing food for geese was reduced, and geese were hazed or otherwise frightened upon their arrival in late fall. In summer, an aircraft, an airboat, gas-powered exploders, assorted firecrackers, rockets, and scarecrow-type devices were assembled. In 1965, the peak Canada goose population at Horicon was estimated at 120,000 birds. In November 1966, after hazing, peak population was 150,000. The U.S. Fish and Wildlife Service had specific plans to again harass Canada geese to reduce their peak fall population at the Horicon National Wildlife Refuge from 200,000 to 100,000 by 1980.

80. GIRARD, G. L. 1941. The mallard: its management in western Montana. Journal of Wildlife Management 5:233–259.

Before the hunting season, mallards (*Anas platyrhynchos*) usually forage in the wheat fields at any time of the day, but mostly in the evening and at night. The largest flights return to the water between 0730 and 0830 h. During the hunting season, when legal shooting hours are from 0700 to 1600 h, almost all mallards return to water areas between 0530 h and 0715 h and leave in large flocks for the fields between 1630 and 1800 p.m. After the hunting season, the birds again change their habits.

81. GLOVER, F. A. 1956. Nesting and production of the blue-winged teal (*Anas discors* Linnaeus) in northwest Iowa. Journal of Wildlife Management 20:28–46.

In 1948, the nest of one blue-winged teal (*Anas discors*) was destroyed by bluegrass seed-stripping machinery. Another nest was deserted by the female after curious workmen visited the nest several times a day. A nest in Whitford's Slough in 1949 apparently was deserted by the female after she was flushed by the investigator. This was unusual because most females usually returned to their nests within a few hours. At Barringer's Slough in 1949, an incubating female in dense nesting cover was inadvertantly stepped on by the investigator. Two of her eggs were broken. The female flew about 28.2 m (30 yards) and landed in dense vegetation. Damaged eggs were carefully removed from the nest and the cover returned to its original appearance. One week later the female had a brood of ducklings. Flushing the ducks from nests probably had no detrimental effect on nesting success. Nine of 10 successful nests in Dewey's Pasture in 1949 were located by flushing the female. At Whitford's Slough, the investigators found two of the three successful clutches by flushing the hens.

82. GOSS-CUSTARD, J. D., AND K. CHARMAN. 1976. Predicting how many wintering waterfowl an area can support. Wildfowl 27:157–158.

This short paper discusses and contrasts methods for studies of brants (*Branta bernicla*) in southeast England (K.C.) and wading birds (Charadrii) and shelducks (*Tadorna* sp.) on the Wash.

83. GÖTMARK, F., AND M. ÅHLUND. 1984. Do field observers attract nest predators and influence nesting success of common eiders? Journal of Wildlife Management 48:381–387.

The authors investigated whether avian predators are attracted to islands in southern Sweden where observers flush incubating common eiders (*Somateria mollissima*). The abundance of hooded crows (*Corvus cornix*) was slightly lower after than before disturbance, although many common eider nests were exposed after disturbance. After disturbance, crows did not increase foraging effort or success in finding nests on the islands. Herring gulls (*Larus argentatus*) and great black-backed gulls (*L. marinus*) were slightly attracted to the disturbed islands and tended to increase their foraging effort and success. Although we observed more depredations after than before disturbance, clutch size and frequency of robbed nests did not differ ($P > 0.10$) between disturbed and undisturbed islands. All nests were covered by the observers and this probably protected the nests; predation was much higher on simulated nests with exposed eggs than on those covered with down.

84. GREENWOOD, R. J., A. B. SARGEANT, D. H. JOHNSON, L. M. COWARDIN, AND T. L. SHAFFER. 1982. Mallard nest success and recruitment in prairie Canada. Transactions of the North American Wildlife and Natural Resources Conference 52:298–309.

Nesting success was determined for several species of ducks nesting in the grassland region of prairie Canada. Nests of mallards (*Anas platyrhynchos*) that were abandoned within a few days after discovery were considered to be investigator-influenced and were not used to measure survival.

85. GRIEB, J. R. 1970. The shortgrass prairie Canada goose population. Wildlife Monograph 22, The Wildlife Society, Washington, D.C. 49 pp.

Before hunting of birds at the Waggoner Ranch in 1969, adequate refuge was available for the birds. Since that time, Canada geese (*Branta canadensis*) have been constantly shifted about in the general area and no adequate provision has been made for their protection. Admittedly, harvest has improved under such a situation, but harvest cannot be controlled and the population could be reduced. Keeping these birds spread over their general wintering area would be better than concentrating them on a single refuge area that may promote firing lines.

86. GUNN, W. W. H. 1973. Environmental stress on the whistling swan. Wildfowl 24:5–7.

Tundra swans (*Cygnus columbianus*) are relatively undisturbed on the Mackenzie Delta, but the delta is now a center of exploration for underlying fossil fuels. A major oil spill will be a continuous threat for many years and, perhaps more important, human and mechanical disturbance on an unprecedented scale is a virtual certainty. The skidoo, or snowmobile, is jeopardizing the safety of the isolated Arctic Coast. Promotion of skidoos is intense and Eskimos have taken to them enthusiastically. Snowmobiles make it possible to cover long distances along the coast, and tundra swans are a large and tempting target for snowmobilers.

87. HANSEN, H. A., P. E. K. SHEPHERD, J. G. KING, AND W. A. TROYER. 1971. The trumpeter swan in Alaska. Wildlife Monograph 26, The Wildlife Society, Washington, D.C. 83 pp.

This study on the Copper River revealed that disturbance by humans during the brood season should be kept at a minimum. Frequent visitors were commercial and sports fishermen, casual visitors, photographers, hikers, picnickers, hunters, target shooters, and others in recreational pursuits. Although trumpeter swans (*Cygnus buccinator*) on the Copper River Delta may not have been molested intentionally by the public, the varied and more frequent level of human activity seems to have had a detrimental effect. A forced and rapid movement of cygnets to a less secure body of water in response to human intrusion seemed to be the most important cause of increased mortality rates. Trumpeter swan broods left natal ponds in response to disturbances.

88. HANSON, W. C., AND L. L. EBERHARDT. 1971. A Columbia River Canada goose population, 1950–1970. Wildlife Monograph 28, The Wildlife Society, Washington, D.C. 61 pp.

Humans occasionally removed eggs from nests of Canada geese (*Branta canadensis*), broke eggs, or destroyed nest markers on lower islands 18, 19, and 20 which were open to the public. The greatest damage from humans, however, was harassment caused by picnics, beach parties, photographing nests, and so on. Originally, the beginning of the goose nesting season was publicized by the news media with appeals for people to stay off the islands until mid-May; however, destruction of nests was less without publicity during later years of the study.

89. HANSSON, L. 1966. Studies on the adaptation of the mallard (*Anas platyrhynchos*) to urban environments. Vår Fågelvärld Supplementum 4:95–140.

When ice forms on the river, mallards (*Anas platyrhynchos*) concentrate in ice-free holes, which exceptionally cold weather may reduce to two. Counting the mallards is not difficult until they number 1,000. The birds are exposed to some disturbances from wanderers along the river bank and from the investigator. During the summer, traffic on the river is heavy. Motor boats seem to have increased in number during recent years. Mallards living in town during summer seem to have adapted to this traffic and ignore it completely. The greatest disturbance is people wandering or skating on the ice in winter. Such disturbance during a census required another count. Birds are in the habit of circling above the river during a disturbance and usually return soon after the disturbance has ceased.

90. HEITMEYER, M. E. 1985. Wintering strategies of female mallards related to dynamics of lowland hardwood wetlands in the Upper Mississippi Delta. Ph.D. thesis, University of Missouri, Columbia. 376 pp.

Wintering mallards (*Anas platyrhynchos*) in the Mingo Basin changed their habitat use, daily time budgets, and food habits in response to human-related disturbance, mainly hunting, but also vehicular and foot traffic. Refuge areas were especially important during hunting seasons as evidenced by concentrations of mallards on certain areas. Effects of disturbance by hunters are not entirely known. Disturbance seems most detrimental to mallards in late winter and spring.

91. HENRY, W. G. 1980. Populations and behavior of black brant at Humboldt Bay, California. M.S. thesis, Humboldt State University, Arcata. 111 pp.

Use of specific areas and daily flight activity by brants (*Branta bernicla*) were influenced by tidal level, food availability, time of day, and particularly by disturbance from hunters. Densities of brants were lower in areas with human activity than in undisturbed areas. In response to open-water hunting, brants left the bay and flew to the ocean where food was scare. Brants were particularly susceptible to disturbance by aircraft, especially helicopters. Flights below 300 m often caused flocks to move to the ocean. Denying the birds an undisturbed feeding place during the day could result in a loss of energy and a lowering of body weight when the birds need to prepare for northward migration and breeding.

92. HEUSMANN, H. W., AND R. G. BURRELL. 1974. Park mallards. Pages 77–86 *in* A symposium on wildlife in an urbanizing environment. 27–29

November 1973, Springfield, Mass. Massachusetts Cooperative Extension Service, Amherst.

Most destruction of nests and broods may be from human disturbance. During the spring of 1973, two youngsters were rowing around a lake collecting eggs from mallard (*Anas platyrhynchos*) nests. Another person reported many people in motorboats intentionally ran down broods of ducklings and one beat several ducklings to death with paddles. We also received reports of ducks in parks being stoned or clubbed to death. Well-meaning people can also cause nest destruction. At Norumbega park, employees of a motel brought food daily to a nesting mallard, but the nest was destroyed by a predator that may have been attracted by the scent of the food. Results of a questionnaire and interviews with people observing or feeding the ducks are included.

93. HEYLAND, J. D., AND W. T. MUNRO. 1967. The use of helicopters in hunting waterfowl nests. Journal of Wildlife Management 31:200–201.

The helicopter rotor spread was 10.7 m (35 feet) but the area affected by the downdraft was 13.7–15.3 m (45–50 feet) in diameter. The agitation of the nesting cover caused by the downdraft, coupled with the noise of the engine, flushed ducks. In addition to being faster, cheaper, and more efficient, the helicopter has other advantages, such as a reduction in desertion of nests by hens in response to searches by investigators. The day after the survey, none of the nests located by the helicopter crew had been abandoned. By kneeling on a pontoon to locate, examine, and mark nests without landing or leaving the hovering helicopter, no human scent is left, the vegetation is not damaged, and no trails are left for predators.

94. HOCHBAUM, H. A. 1944. The canvasback on a prairie marsh. American Wildlife Institute, Washington, D.C. 201 pp.

When flushed from the nest during egg laying and early incubation periods, female canvasbacks (*Aythya valisineria*) invariably leave by a lane to open water, and then fly if approached too closely. Some leave while a canoe is still 0.4 km (0.25 miles) or more away. Toward the end of incubation, the female is reluctant to leave the nest, and flushes directly from the nest when the intruder is a few yards away. After her absence in response to disturbance, the returning hen may to find her brood dispersed and may fail to retrieve all ducklings.

95. HOCHBAUM, H. A., S. T. DILLON, AND J. L. HOWARD. 1954. An experiment in the control of waterfowl depredations. Transactions of the North American Wildlife Conference 19:176–185.

Observations of the first 2 years of a study at Delta, Manitoba, indicated that patrol of areas by a trained person reduced losses of unharvested grain in outlying fields; a combination of gunfire and scaring devices controlled waterfowl, but gunfire had to persist for several evenings in wet fields and be repeated when the harvest was considerably delayed; and ducks need not be killed to be kept away from grain fields.

96. HUME, R. A. 1976. Reactions of goldeneyes to boating. British Birds 69:178–179.

Unlike elsewhere in late winter and early spring, the abundance of waterfowl did not increase at Chasewater, and in the winter of 1974–75 the abundance was much lower in late January than in December, almost certainly because of the increased frequency of midweek boating. Repeated observations revealed that common goldeneyes (*Bucephala clangula*) often fly when people on the shore approach closer than 100 or 200 m, but invariably settle again elsewhere on the water. A single sailing dinghy, however, may be sufficient to cause more than 60 common goldeneyes to take flight and most to leave entirely within a few minutes. Remaining birds then fly up each time the boat approaches to within 300–400 m and generally leave within an hour. The appearance of a powerboat causes instantaneous flight by most birds. If the boat traverses the length of the reservoir, all remaining birds leave within minutes.

97. HUMMEL, V. D. 1980. Durchzug und Überwinterung der Kurzschnabelgans (*Anser*

brachyrhynchus) im Bereich der Nordseeküste (1974–1977). (Migration and winter distribution of the pink-footed goose [*Anser brachyrhynchus*] in the coastal area of the North Sea [1974–1977]). Die Vogelwelt 101:121–131.

Pink-footed geese do not rest long along the entire German coast, particularly not at the time of duck hunting. Hunting so disturbs the birds, they are quickly on their way. (translated)

98. HUNT, E. G., AND W. ANDERSON. 1966. Renesting of ducks at Mountain Meadows, Lassen County, California. California Fish and Game 52:17–27.

In 1956, desertion of nests by hens was 29.5%, about 10% higher than recorded in 1954. This increase probably resulted from disturbance of normal nesting activities by trapping of nesting hens. Nesting mallards (*Anas platyrhynchos*) were difficult to trap and deserted readily.

99. JAHN, L. R., AND R. A. HUNT. 1964. Duck and coot ecology and management in Wisconsin. Wisconsin Conservation Department Technical Bulletin 33, Madison. 164 pp.

Included bulletin is a review of Zimmerman's (1953) paper that reported some Wisconsin lakes bordered with homes were so heavily used for recreation in the early 1940's that breeding ducks were discouraged from using otherwise suitable habitat. Human activities on and near permanent water have increased tremendously. Activities of shore residents, anglers, and boaters seem to discourage breeding waterfowl from using otherwise adequate habitat. Aerial waterfowl censuses revealed many lakes with excellent stands of submerged aquatic plants but without ducks. This is especially true of lakes 405 ha (1,000 acres) or smaller with many piers and boats.

100. JESSEN, R. L. 1981. Special problems with diving ducks. Paper presented to the Fourth International Waterfowl Symposium, New Orleans, Louisiana, 31 January–1 February 1981. Minnesota Department of Natural Resources, St. Paul. 8 pp.

Availability of lesser scaups (*Aythya affinis*) for hunting, especially in the Upper Midwest, is influenced by wariness of the birds and their intolerance to disturbance. A largely unrecognized wariness of lesser scaups to all kinds of disturbances, especially hunting, reduces their use of many habitats in the lake region of the Upper Midwest. Development of appropriate harvest techniques could improve the take of these birds by hunting. Such techniques should emphasize availability of feeding and resting areas rather than seasons and larger bag limits.

101. JESSEN, R. L., J. P. LINDMEIER, AND R. E. FARMES. 1964. A study of duck nesting and production as related to land use in Mahnomen County, Minnesota. Pages 26–85 *in* J. B. Moyle, editor. Ducks and land use in Minnesota. Minnesota Department of Conservation, Division of Game and Fish Technical Bulletin 8.

The authors report mean flushing distance of blue-winged teal (*Anas discors*) and mallard (*A. platyrhynchos*) hens as related to stage of nesting, repeated visits to the nest, and stage of incubation.

The authors believed that careful observers do not significantly increase predation of nesting hens. Nest losses from human intrusion were due primarily to desertion by hens. Increased predation because of human intrusion was insignificant.

102. JOENSEN, A. H., AND J. MADSEN. 1985. Waterfowl and raptors wintering in wetlands of western Greece, 1983–85. Natura Jutlandica 21:169–200.

In the Amvrakikos wetlands, studies were conducted on distribution of ducks and Eurasian coots (*Fulica atra*) in relation to food resources and human disturbance, especially hunting. The number of hunters is large and practices are frequently illegal, including killing of protected species. Disturbance by hunters often causes mass displacement of ducks from the most important feeding areas. Some species such as northern pintails (*Anas acuta*), northern shovelers (*A. clypeata*), green-winged teals (*A. crecca*), and common pochards (*Aythya ferina*) are very sensitive to disturbance. Northern shovelers and northern pintails cease to feed in response to shooting near them, whereas Eurasian wigeons (*Anas penelope*) and Eurasian coots are less sensitive and continue foraging at lower intensity. Shooting from motor boats is extremely disturbing. Sportsmen in only one or two powered punts in Logarou Lagoon and equivalent numbers in the Koronisia Bay can disturb waterfowl so that the birds stop feeding and eventually abandon the area. Poled fishing punts move rather slowly and cause less disturbance. Motor boats flush waterfowl and interrupt feeding for a much longer time. In the Koronisia Bay, fishing boats regularly displace ducks from feeding areas.

103. JOHNSON, F. A., AND F. MONTALBANO. 1984. Selection of plant communities by wintering waterfowl on Lake Okeechobee, Florida. Journal of Wildlife Management 48:174–178.

The authors censused ducks from a fixed wing aircraft. Biases associated with their method of collecting data include the possible differential visibility of ducks in certain coverts. The authors believed that this bias, although not quantifiable, was reduced because birds tended to flush in front of the aircraft.

104. JOHNSON, R. E. 1964. Fish and fowl. Pages 453–458 *in* J. P. Linduska, editor. Waterfowl tomorrow. U.S. Department of Interior, Fish and Wildlife Service. U.S. Government Printing Office, Washington, D.C.

If waterfowl use heavily fished waters for breeding, resting, or feeding, they will be disturbed often by anglers who use boats or fish from the banks. The author suggested that this conflict can be resolved by zoning certain water areas for use by waterfowl or by anglers or by restricting fishing during the season when waterfowl are nesting and rearing broods.

105. JONES, J. J. 1981. Potential effects of winter shipping on diving ducks wintering on the Detroit River. M.S. thesis, University of Michigan, Ann Arbor. 91 pp.

The author believes winter navigation, if initiated, could pose a serious threat to wintering waterfowl for three major reasons. Icebreaking activities could cause ice to be diverted to areas that were previously ice-free during winter. Areas that are susceptible to being covered by diverted ice include important foraging sites for wintering waterfowl. This could decrease availability of food for waterfowl. Winter shipping may adversely affect food abundance by the resuspension of fine substrates. The coarser substrates left behind could limit important waterfowl foods. Wintering waterfowl on the Detroit River were depleting their endogenous energy reserves even when critical shallow water depths were available for feeding. Loss of feeding habitat from long periods of ice cover may force major portions of the population to either migrate with low lipid reserves or to starve to death.

106. JONES, R. D., JR. 1964. Age group counts of black brant in Izembek Bay, Alaska. Wildfowl 15:147–148.

Observation points were chosen because they were free of waterfowl hunters and brants (*Branta bernicla*) therefore approached the shore more closely.

107. JONES, R. D., JR. 1973. A method for appraisal of annual reproductive success in the black brant population. M.S. thesis, University of Alaska, Fairbanks. 117 pp.

Brants (*Branta bernicla*) were not alarmed by an observer, even though he moved a bit, if he did not stand upright. Bright yellow oilskins, regular apparel of people in the Izembek Lagoon, did not deter approaching birds. Disturbing factors, in addition to waterfowl hunters, included airplanes and avian predators.

108. JONES, R. D., JR., AND D. M. JONES. 1966. The process of family disintegration in black brant. Wildfowl 17:75–78.

Familial flocks of brants (*Branta bernicla*) were easily excitable and quarrelsome. They scrambled into flight at the approach of an airplane or an avian predator. Later, after disintegration of family groups, only low flying aircraft disturbed the large amorphous flocks. In September no juveniles were unattached from family groups. Between 23 September and 18 October, the degree of interaction in these flocks and the disposition to fly at the approach of an airplane clearly increased. When the breakup of families was complete, the population was composed of a few very large flocks with all age groups. Hostile encounters were rare and the flock was not disturbed by an approaching airplane.

109. KALMBACH, E. R. 1937. Crow–waterfowl relationships: based on preliminary studies on Canadian breeding grounds. U.S. Department of Agriculture Circular 433. 36 pp.

The author emphasized strongly that careless intrusion of humans into duck-nesting areas creates a serious hazard. Incubating ducks may be flushed in the presence of American crows (*Corvus brachyrhynchos*) and the suddenly uncovered eggs left exposed to view. Breeding grounds should be carefully guarded from trespassers.

110. KEITH, L. B. 1961. A study of waterfowl ecology on small impoundments in southeastern Alberta. Wildlife Monograph 6, The Wildlife Society, Washington, D.C. 88 pp.

The effect of human intrusion on predation during nesting studies has always been controversial. Tracks and trails leading to nest, nest markers, disturbance of nest cover, and nest-finding activity have been cited as increasing predation. The author believes threat to waterfowl is much more serious where sport fish occur and general disturbance is caused by anglers. Fishing is a popular recreation on the prairies, and available waters are heavily used. Breeding birds and their young seem to find this disruption intolerable. Waterfowl populations and production seem to be low under these circumstances. In Alberta, this danger has recently grown because small impoundments that previously lacked fishes are now being stocked with trout (*Salmo* spp.).

111. KNITTLE, C. E., AND R. D. PORTER. 1988. Waterfowl damage and control methods in ripening grain: an overview. U.S. Fish and Wildlife Service Fish and Wildlife Technical Report 14. 17 pp.

Many methods are available to reduce losses of grain to waterfowl, but success varies. Hazing with exploders, shotguns, rifles, pyrotechnic devices, scarecrows of many descriptions, and aircraft can be used to frighten waterfowl.

112. KORSCHGEN, C. E., L. S. GEORGE, AND W. L. GREEN. 1985. Disturbance of diving ducks by boaters on a migrational staging area. Wildlife Society Bulletin 13:290–296.

Disturbances of canvasbacks (*Aythya valisineria*) by recreational boaters were studied on the upper Mississippi River to determine frequency of disturbance and possible effects on energy of the birds. Twenty-nine random observation periods during morning (30 min before sunrise to 1200 h) and afternoon (1200 h to sunset) were used to determine numbers, dominant activity, and distribution of the birds on the staging area. Recreational boating that created disturbance, flock size, and duration of response were recorded. An average of 17.2 boats per day resulted in 5.2 disturbances per day. Anglers created 42% of the disturbances. Mean flock size of disturbed canvasbacks was 12,474. Disturbances lasted an average of 4.43 min each. Diving ducks left the staging area 19 times during the fall because of human disturbance. Birds may be forced to fly up to 1 h each day because of disturbance. Energetic costs of the disturbances are unknown, but may be detrimental if the abundance of canvasbacks significantly increases and requires more food, production of American wildcelery (*Vallisneria americana*) significantly decreases, disturbances become more severe, or foods at other migration areas deteriorate.

113. KRAMER, D. 1984. The effects of recreational activities on the winter wildfowl population at Priory Park Lake, Bedford, during the winter of 1982–83. Ardea 1983–84:34–46.

Counts of wintering wildfowl were made at a 25-ha gravel pit lake before and after sailing and sail-boarding; abundance of wildfowl with and without disturbance were compared. Recreation on the lake was restricted to a particular zone between 1 November and 28 February 1983. The effect of a disturbance-free zone on the behavior and distribution of waterfowl was noted. Before zoning, sailing displaced nearly all waterfowl from the lake. During the first month of zoning, sailing still caused a significant reduction in number of birds and species, but thereafter, nearly all species tolerated the presence of sail-boards and dinghies and remained on the lake in similar abundance as on undisturbed days. Species included northern shovelers (*Anas clypeata*), green-winged teals (*A. crecca*), Eurasian wigeons (*A. penelope*), mallards (*A. platyrhynchos*), gadwalls (*A. strepera*), common pochards (*Aythya ferina*), tufted ducks (*A. fuligula*), Canada geese (*Branta canadensis*), common goldeneyes (*Bucephala clangula*), long-tailed ducks (oldsquaw, *Clangula hyemalis*), and mute swans (*Cygnus olor*). Results in this paper are similar to those in the publication by the same author reviewed below.

114. KRAMER, D. 1986. The effects of recreational activity on wintering wildfowl populations at Priory Park Lake, Bedford. Bedfordshire Naturalist 41:21–26.

A 25-ha lake was selected and a disturbance-free zone created. Two visits per day were made on 39 occasions between 18 September 1982 and 28 February 1983. Canada geese (*Branta canadensis*) were present only once and the flock was obviously alarmed by the first launched boat and departed immediately. Eurasian wigeons (*Anas penelope*) did not seem to be disturbed by the sailing. Mallards (*A. platyrhynchos*) were affected by the sailing and deserted the lake. Walking, jogging, fishing, or dog-walking people along the lakeshore had little effect, except when a dog owner deliberately sent a dog into the water and when the sudden movement of a person breaking into a fast run caused a party of 10 common goldeneyes (*Bucephala clangula*) to depart from the lake. Before zoning, a low level of disturbance resulted in near total departure of all water birds and some species such as the green-winged teal (*A. crecca*) took flight as soon as a single sailboard or dinghy was launched, whereas common pochards (*Aythya ferina*) and tufted ducks (*A. fuligula*) departed as soon as the craft approached within about 80 m of the flocks. Common pochards and tufted ducks continued to be disturbed by sailing for several weeks (common pochards for 5 weeks) after the refuge was zoned. Learning probably took place.

115. KRAMER, G. W., L. R. RAUEN, AND S. W. HARRIS. 1979. Populations, hunting mortality and habitat use of black brant at San Quintin Bay, Baja California, Mexico. Pages 242–254 *in* R. L. Jarvis and J. C. Bartonek, editors. Proceedings of the Symposium on Management and Biology of Pacific Flyway Geese, Northwest Section, The Wildlife Society, Washington, D.C.

Use of specific areas of the bay and daily flights by brants (*Branta bernicla*) were disturbed particularly by hunting. On days without hunting, brants left deep-water areas and flew to eelgrass beds. Brant usually did not fly at other times except when disturbed by aircraft, anglers, or boaters. Disturbance by hunters resulted in five to six times more flights than on corresponding nonhunting days. Flights were more frequent, occurred sooner after hunting began, and involved more birds during the 16 January–28 February 1975 portion of the hunting season (spring migration) than earlier. The intensity of movement to the ocean was significantly related to the level of human disturbance. Most brants took flight as aircraft approached and remained airborne until the aircraft passed, but only few ducks and shorebirds reacted similarly. The authors think that departing brants abandoned San Quintin Bay as a stopover area and recommended stricter law enforcement; making herding illegal; continuing rest days during the hunt on Monday, Tuesday, and Wednesday; reducing the bag limit; establishing a refuge area; and avoiding ecological changes that affect eelgrass.

116. KRASOWSKI, T. P., AND T. D. NUDDS. 1986. Microhabitat structure of nest sites and nesting

success of diving ducks. Journal of Wildlife Management 50:203–208.

To minimize nesting failure because of visitation by investigators, the authors revisited nests only once after the expected time of the hatch. Nests believed to be disturbed by investigators were excluded from analyses that compared habitat structure with nesting success. Nesting success was not independent of the time of nest location ($\chi^2 = 4.08$, $df = 1$). Nests found early in the laying stage failed more often than those found later. Thus, the visit to the nest may have contributed to failure.

117. KROHN, W. B., AND E. G. BIZEAU. 1980. The Rocky Mountain population of the western Canada goose: its distribution, habitats, and management. U.S. Fish and Wildlife Service Special Scientific Report—Wildlife 229. 57 pp.

Data are presented that identify desertion and destruction, irrespective of underlying cause, as the causes of most losses of nests of Canada geese (*Branta canadensis*). This has important management implications because desertion can be minimized in areas with much human activity by regulating fishing seasons and access during the nesting season. A net gain in goslings was recorded from elevated nest structures. The authors concluded that structures were useful if they were maintained annually and located in areas away from people. The authors recommended that to more closely control the harvest of Canada geese from individual breeding regions, managers should encourage Canada geese to molt in the region where the birds hatched. This could be accomplished by restricting recreational use and banding on lakes and reservoirs used by molters during July and August. A lack of disturbance seems especially critical to molters that are just starting to use an area.

118. LAPERLE, M. 1974. Effects of water level fluctuation on duck breeding success. Pages 18–30 *in* H. Boyd, editor. Canadian Wildlife Service waterfowl studies in eastern Canada, 1969–73. Report Series 29. Canadian Wildlife Service.

Searching and examination of nests were reduced from 1968 to 1970 and this reduced disturbance of hens by observers. Nevertheless, the American black duck's (*Anas rubripes*) nesting success declined from 64% in 1968 to 53% in 1969 and 44% in 1970. The nesting success of mallards (*A. platyrhynchos*), however, was 36%, 73%, and 61% in the same years. The low in 1968 was attributed to the intensive effort of capturing mallard hens on nests.

119. LEBEDA, C. S., AND J. T. RATTI. 1983. Reproductive biology of Vancouver Canada geese on Admiralty Island. Journal of Wildlife Management 47:297–306.

A molting flock of about 300 Canada geese (*Branta canadensis*) at Fools Inlet was monitored weekly. Flightless Canada geese on water or in the intertidal zone fled into the forest when approached by observers in a boat. Similar behavior by flightless Vancouver Canada geese was observed in Adams Inlet in 1973 by Ratti et al. (1977). The authors recommended that human disturbance on Admiralty Island should be monitored and limited in some areas. Tiedeman Island (an island in the Admiralty Island complex) has an important concentration of breeding Canada geese and should also be addressed in management of disturbances by recreation. Known molting sites, such as Fools Inlet and Adams Inlet, should be protected from human disturbance during the molting period. Elsewhere, human disturbance resulted in desertion of the area by molting Canada geese (Sterling and Dzubin 1967).

120. LEE, F. B., R. L. JESSEN, N. J. ORDAL, R. I. BENSON, J. P. LINDMEIER, R. E. FARMES, AND M. M. NELSON. 1964. Ducks and land use in Minnesota. Minnesota Department of Conservation Technical Bulletin 8. 140 pp.

In the Mahnomen study area, 9% of located nests were deserted by hens, in Otter Tail study area 8% and in Pope study areas, 12%. Some desertion can be attributed to rope-dragging of nesting areas and to visits of nests by investigators.

121. LIDDLE, M. J., AND H. R. A. SCORGIE. 1980. The effects of recreation on freshwater plants and animals: a review. Biological Conservation 17:183–206.

This paper is a review of the effects of recreation on freshwater plants and animals. The paper makes a distinction between water- and shore-based activities and between physical and chemical effects. Effects of water-based recreation, mainly from boating, are discussed in terms of wash, turbulence and turbidity, propeller action, direct contact, disturbance to animals, and pollution from outboard motors and sewage. Effects from shore-based activities, such as angling and swimming, include trampling and associated effects, as well as effects of sewage and other chemicals. Management of recreation is also considered. Information on the effect of recreation is greater on plants than on animals, but the authors consider that further research is required in both fields. Some possible approaches are presented. This review and the section on disturbance are extensive.

122. LOOSJES, M. 1974. Over terreingebruik, verstoringen en voedsel van grauwe ganzen (*Anser anser*) in een brak getijden-gebied (Habitat use, disturbances and food of graylag geese [*Anser anser*] in a brackish tidal area). Limosa 47:121–143.

Graylag geese sleep principally in a dry-rush area, however, often on mudflats because of disturbance. Voluntary dispersal in the Beninger Slikken usually did not have a fixed pattern. Graylag geese fled from disturbance to mudflats or adjoining water. In response to serious disturbance, they fled to mudflats. Hunting and airplanes are disturbing. During daytime, graylag geese are disturbed an average of one-third of the time and flee four times a day. In stormy weather with high tide, graylag geese flee to grassland outside the dikes. Damming of the estuary in autumn 1970 is harmful because of greater portions of fresh water, probably increased pollution, ceasing of tides, and increase of disturbance. Other threats are increase of recreation, industrialization, aerial traffic, and a decrease of refuge.

123. MACINNES, C. D. 1962. Nesting of small Canada geese near Eskimo Point, Northwest Territories. Journal of Wildlife Management 26:247–256.

On one occasion, 16 parasitic jaegers (*Stercorarius parasiticus*) landed at a single snow goose (*Chen caerulescens*) nest within 30 sec of the departure of the incubating hen. The extent of predation by parasitic jaegers increased by disturbance in the nesting area of Canada geese (*Branta canadensis*), particularly by the presence of a man. In 1959, often 30 or 40 jaegers were observed within 91.4 m (100 yards) of a man in the blue goose colony.

124. MACINNES, C. D. 1980. Comment: observer-induced predation is real. Journal of Wildlife Management 44:222–224.

This article is a response to Strang's questioning (see paper 183) of predation by parasitic jaegers (*Stercorarius parasiticus*) induced by the observer. MacInnes defended his position and suggested that predator density at Strang's study area may have been less and agreed further work had to be done to define observer-induced losses of waterfowl nests.

125. MACINNES, C. D., AND R. K. MISRA. 1972. Predation on Canada goose nests at McConnell River, Northwest Territories. Journal of Wildlife Management 36:414–422.

Predation of clutches of small Canada geese (*Branta canadensis*) were observed from 1965 to 1969 on a 62-km^2 study area at the mouth of the McConnell River, Northwest Territories. Partial clutches were lost because of disturbance by humans. Losses of partial clutches were 55% of all lost eggs after repeated visits to individual nests. The proportion of completely destroyed nests did not vary among years, but the proportion of partial loss of eggs changed significantly. The latter difference was due to changes in predator activity or interaction with humans and not only to changes in human activity. Number of eggs lost per visit was the same (0.65 egg per visit) for all clutch sizes except six (0.26 egg per visit). More small clutches were destroyed because the lost eggs represented a higher proportion of the initial clutch. In the absence of human disturbance, losses of eggs to predation would have been about 10% and varied little from year to year despite demonstrated changes in predator activity. A large population of arctic foxes (*Alopex lagopus*), absent during this study, can raise loss of eggs to predation.

126. MACINNES, C. D., R. A. DAVIS, R. N. JONES, B. C. LIEFF, AND A. J. PAKULAK. 1974. Reproductive efficiency of McConnell River small Canada geese. Journal of Wildlife Management 38:686–707.

Disturbance of Canada geese (*Branta canadensis*) from widespread searching during the laying period was evident by 1967 and caused increased predation (MacInnes and Misra 1972). Consequently, as of 1968, searches were less frequent early in the season and on less than one-third of the study area. Nests were observed until the first young hatched, and broods were enumerated when families reached the feeding area. In the intervening period, many goslings were lost, but the researchers did not attempt to locate broods at this time because the concomitant disturbance caused heavy predation by herring gulls (*Larus argentatus*). In the abstract, the authors stated that about half the predation was due to human disturbance and caused the loss of 13–31% of eggs.

127. MADSEN, J. 1984. Study of the possible effect of oil exploration on goose populations in Jameson Land, East Greenland. A progress report. Norsk Polarinstitutt Skrifter 181:141–151.

Molting geese are extremely shy and wary and respond to noise of distant helicopters. A significant interspecific difference exists in both the distance of reaction and the intensity of response. In certain situations, the pink-footed geese (*Anser brachyrhynchus*) react to helicopters at a distance of 20 km by swimming to open water at 10 km distance and clumping in panic when the helicopter is 4 km away. Barnacle geese (*Branta leucopsis*) are less shy and react only moderately to helicopters at a distance of only 1–2 km; they usually do not react to helicopters at a 4 km distance. A pedestrian at a lake often drives off molting geese, especially pink-footed geese. When geese are forced to cross the tundra, they risk predation by the arctic fox (*Alopex lagopus*). Geese may return later in the molting period to lakes that are connected with a river or a coast, but not to remote lakes.

128. MADSEN, J. 1985. Habitat selection of farmland feeding geese in West Jutland, Denmark: an example of a niche shift. Ornis Scandinavica 16:140–144.

Apart from habitat type, disturbance level and tolerance of disturbance are important factors that segregate the two goose species. In autumn 1982, the majority of the Svalbard population had arrived on Filsö by 8 October, but most geese were scared off by the farmer who feared damage to his crops of winter wheat. The highest use by pink-footed geese (*Anser brachyrhynchus*) was on fields far away from sources of disturbance and with wide open views. These attributes did not seem as important to graylag geese (*A. anser*), which avoided the fields that pink-footed geese frequented and sought fields near roads that pink-footed geese avoided. Graylag geese tolerated a shorter distance from humans and vehicles (100–300 m) than pink-footed geese (300–600 m). The distance increased with flock size. The tolerance of disturbance level contributes to the niche segregation of the two species. The geese are concentrated in a relatively small area with high disturbance levels. Because of farming operations and traffic, geese are daily chased from one part of the farmland to another with a consequent concentration in large flocks.

129. MADSEN, J. 1985. Impact of disturbance on field utilization of pink-footed geese in West Jutland, Denmark. Biological Conservation 33:53–63.

The effect of roads and landscape features on use of fields by pink-footed geese (*Anser brachyrhynchus*) in autumn and spring is reported. Flight distance of goose flocks increases with flock size and is longer in autumn than in spring. Roads with traffic volume of more than 20 cars per day disturb geese from distances of about 500 m in autumn and from a lesser distance in spring. Lanes with 0–10 cars per day also disturb geese and reduce their use of fields. Such features as windbreaks and banks, which block an open view, disturb geese from a distance of about 200–300 m. The width of an area (hindrances in more than one direction) must exceed 500 m to be accepted by flocks of pink-footed geese in autumn.

130. MADSEN, J. 1985. Relations between change in spring habitat selection and daily energetics of pink-footed geese (*Anser brachyrhynchus*). Ornis Scandinavica 16:222–228.

Pink-footed geese (*Anser brachyrhynchus*) put to flight by disturbance must compensate for the lost feeding time and higher energy expenditure by spending more time feeding in the hours after the disturbance. The daily net energy intake for the birds feeding on newly sown fields was twice as high as for birds feeding in pastures. Converted into net energy intake per peck, the geese on the newly sown fields had 16 times more net intake per peck than geese on pastures. If the geese grazing on pastures in West Jutland spent the same daily amount of time flying as geese feeding on newly sown fields (1 h), they would not be able to compensate for the energy lost while flying unless they increased pecking rates or the time spent feeding. The energy content and availability of food are very crucial to replenishment of energy by migrant geese.

131. MADSEN, J. 1988. Autumn feeding ecology of herbivorous wildfowl in the Danish Wadden Sea, and impact of food supplies and shooting on movements. Danish Review of Game Biology 13:1–32.

In autumn, the southern part of the Danish Wadden Sea is an important staging area for brants (*Branta bernicla*) (peak numbers 6,000), green-winged teals (*Anas crecca*) (3,500) and Eurasian wigeons (*A. penelope*) (15,000). In 1985, shooting of ducks on the mud flats was moderate, whereas in 1986, it was intensified, displacing ducks and brants to a non-shooting zone. This zone was soon depleted of resources, and most of the waterfowl left the area earlier than in 1985, even though food was still available in the shooting zone. Birds fed in the shooting zone at night. The abundance of waterfowl was limited by food and switching between habitats by geese was linked to depletion of food stocks. Shooting modified movements and caused birds to leave the area prematurely.

132. MAHER, M. 1982. Response by waterfowl to hunting pressure: a preliminary study. Australian Wildlife Research 9:527–531.

The movements of ducks to refuges in response to hunting pressure were investigated during the opening of the 1981 duck season. Gray teals (*Anas gibberifrons*), Australian shovelers (*A. rhynchotis*), Australian black ducks (*A. superciliosa*), and Australian white-eyed ducks (*Aythya australis*) sought refuge whereas pink-eared ducks (*Malacorhynchus membranaceus*) did not. Some implications for management are discussed.

133. MATHEWS, G. V. T. 1982. The control of recreational disturbance. Chap. 42. Pages 325–330 *in* D. A. Scott, editor. Managing wetlands and their birds, a manual of wetland and waterfowl management. Proceedings 3rd Technical Meeting on Western Palearctic Migratory Bird Management, Biologische Station Rieselfelder Münster, Federal Republic of Germany, 12–15 October 1982.

Water-based recreationists increased sevenfold in the last 30 years. In Britain, nearly 4 million anglers, half a million boaters, half a million birdwatchers, and other millions affect wetlands. Activities that cause disturbance to waterfowl in order of decreasing disturbance include:

1. those involving rapid movement and loud noise (power boating, water skiing, cruising);
2. those involving movement but little noise (sailing, wind surfing, rowing, canoeing);
3. those involving little movement or noise (sub-aqua, swimming); and
4. those carried out largely from the banks (coarse fishing, game fishing, birdwatching, informal).

Boats must be kept at least 300 m from a waterfowl area. Banks are more easily zoned than water itself, and bird areas must be strictly off limits to anglers. The paper also addresses accommodation of birdwatchers and use of wetland display centers to educate the general public.

134. McKENZIE, D. F. 1987. Utilization of rootstocks and browse by waterfowl on moist-soil impoundments in Missouri. M.S. thesis, University of Missouri, Columbia. 93 pp.

Human disturbance frequently prevented waterfowl from using habitat. Attempts to collect waterfowl eliminated most or all waterfowl use for a few days from a unit that had been supporting large concentrations of birds. This bias from research form the basis for the opportunistic nature of the censuses. Systematic walk-through counts would have caused additional human disturbance to waterfowl. Unpredictable disturbance from the public is an unknown variable that undoubtedly biased the census data. The number of waterfowl in studied impoundments did not change when the hunting season opened.

135. MELTOFTE, H. 1982. Jagtlige forstyrrelser af svømme-og vadefugle (Shooting disturbances of waterfowl). Dansk Ornithologisk Forenings Tidsskrift 76:21–36.

During the hunting season hunters were present during daytime at more than half the visits by bird censusers in about half of the most important shallow-water areas. At dusk and dawn, hunting is even more intense. In western Jutland, about 90% of the ducks are found in 20% of the shallow-water area protected from shooting. In autumn, large changes in bird distribution occur in connection with the start and end of shooting. Although much information exists on displacement by hunting, little information is available about the ecological consequences of this for waterfowl. As autumn and winter proceed, feeding becomes progressively more difficult. In winter, disturbances probably have more severe consequences for waterfowl. Probably few individual waterfowl in Danish wetlands during autumn avoid being shot at or being in a flock which is shot at. Even in the sedentary Danish mute swan (*Cygnus olor*) population, which has been fully protected for 50 years, about 25% carry shot in their tissue. Such extreme hunting intensity has led to great wariness in the birds, so that other innocuous human activities may cause serious disturbances.

136. MENDALL, H. L. 1958. The ring-necked duck in the northeast. University of Maine Bulletin, Vol. LX. 16. University of Maine Studies, Second Series 73. 317 pp.

Such factors as spring trapping and unrestrained fishing, picnicking, and boating are usually associated with unsuccessful breeding by waterfowl. With an objective to produce more ducks, areas must be selected where this priority can be maintained. Neither American black ducks (*Anas rubripes*) nor ring-necked ducks (*Aythya collaris*) produce many young under conditions of excessive human disturbance and soon go elsewhere to nest. Sizes of Class II and Class III broods have averaged more than two birds higher at Portage Lake in northern Maine since the use of motorboats was prohibited by law in the marsh portion of that lake. Of great concern are the effects on waterfowl from increased motor-boating, picnicking, and camping on inland waterways.

137. MICKELSON, P. G. 1975. Breeding biology of cackling geese and associated species on the Yukon–Kuskokwim Delta, Alaska. Wildlife Monograph 45, The Wildlife Society, Washington, D.C. 35 pp.

Human activity near brood rearing areas undoubtedly adversely affected broods. When brood counts were made, parent Canada cackling geese (*Branta canadensis minima*) often outdistanced and deserted their young, leaving them susceptible to the ever-present glaucous gulls (*Larus hyperboreus*). When brood members became separated after having been startled by humans or approaching boats, some young may have been lost. The sound of a boat sent Canada goose families fleeing. Disturbances at onset of nesting caused some reduction in nesting density around the author's camp. Desertion of nests by adult geese was increased as a result of the author checking nests early in the laying period. Trapping of incubating Canada geese on nests resulted in desertions. Loss from predation may have doubled because of the presence of the author on the Onumtuk study area. A restriction of unnecessary human activity is needed on the waterfowl nesting and brood rearing grounds. Checking nests of cackling geese several times prior to hatch resulted in twice the normal loss of eggs to predators, and boating increased predation on young birds.

138. MOOIJ, J. H. 1979. Winterökologie der wildgänse in der Kulturlandschaft des Niederrheins (Winter ecology of wild geese in the cultivated land of the lower Rhine). Charadrius 15:49–72.

Every year, thousands of wild geese winter at the river Rhine between the town of Duisburg and the Dutch–German border, in North-Rhine Westfalia (western Germany). Most are bean geese (*Anser fabalis*), but about 12–22% are greater white-fronted geese (*A. albifrons*). Since the middle sixties, the abundance of geese in this area increased rapidly to a present maximum of 22,000–24,000. At the same time, the concentration of wintering geese moved north because more feeding sites and roosts have been sacrificed for industry and recreation, and as a result, complaints about damage by geese have increased. To save a wintering area of great international importance, to stop constantly increasing disturbance and destruction of roosts and feeding sites by humans, and to make it easier to compensate for possible damage by geese and solve the problems between farmers and geese, establishment of a network of protected refuges for geese along the Rhine is imperative.

139. MOOIJ, J. H. 1982. Die Auswirkungen von Strassen auf die Avifauna einer offenen Landschaft am unteren Niederrhein (Nordrhein-Westfalen), Untersuchung am Verhalten von Wildgänsen (Inquiry into the effects of open-field roads on behavior of wild geese in the North Rhine, Westphalia, Germany). Charadrius 18:73–92.

At the lower Rhine River, a new highway is planned for an area that has risen in importance for geese since the 1960's. Foraging sites of geese are at least 250 m from low-traffic roads such as country lanes and at least 400 m from roads with heavy traffic such as highways. Buffer zones around a central feeding area extend from a road or any other source of disturbance to 350 m into the field; until they are disturbed, geese occasionally use the first 250 m. In the next zone, at a distance of 250–350 m from the source of disturbance, geese feed only irregularly. At a distance of 350–450 m from a road or other source of disturbance, geese are feeding frequently, and at a distance of 450–550 m they are found to feed regularly. The most central part, at least 550 m from every source of disturbance, geese are using very intensely. The proposed new highway (B 9 neu) through die Düffel will reduce the total area of the central feeding places in this region by at least 20%; thus it is not acceptable.

140. MOOIJ, J. H. 1982. The Niederrhein (Lower Rhine) area (North Rhine Westphalia, Federal Republic of Germany), a goose wintering area of increasing importance in the Dutch–German border region. Aquila 89:235–297.

This article discusses international problems at the Dutch–German border, one of which is the difference in hunting regulations between the governments. The result of the ban on hunting in North Rhine Westphalia is that geese wintering in the border region, though still roosting in the Netherlands, feed more on German territory. This leads to actions like those of Dutch hunters, who scare geese feeding in the German border region over the frontier, where their hunting colleagues, warned by walkie-talkie, shoot them.

141. MORGAN, N. C. 1972. Problems of the conservation of freshwater ecosystems. Pages 135–154 *in* R. W. Edwards and D. J. Garrod, editors. Conservation and productivity of natural waters. Symposia of the Zoological Society of London 29.

Water-based recreation is increasing and includes fishing, birdwatching, swimming, canoeing, sailing, rowing, picnicking, and holiday boating of various kinds. Many of these activities are incompatible with each other and variably affect the ecosystem. Cottages on the shore and trailer sites can also have detrimental effects. Few quantitative studies have been done in the United Kingdom on effects of disturbance. Morgan reported an observation by I. Newton who found that disturbance of nesting ducks caused a significant increase in predation on eggs. In a control area with 84 nests, which were not disturbed, 17% were lost to predation and in the disturbed study area with 781 nests, 41% were lost to predation. This difference occurred even though the disturbance amounted to only one or two visits to the nests each week. Conflicting activities can be segregated. Zones can be established as wildlife reserves in which boats, fishing from banks, and picnicking are prohibited. Blinds with screened walkways should be erected for the use of birdwatchers.

142. MORSE, T. E., J. L. JAKABOSKY, AND V. P. MCCROW. 1969. Some aspects of the breeding biology of the hooded merganser. Journal of Wildlife Management 33:596–604.

The authors concluded that hooded mergansers (*Lophodytes cucullatus*) abandoned nests (18.2%) primarily in response to disturbance by the investigators, which was also the main cause of loss of eggs.

143. NEWTON, I., AND C. R. G. CAMPBELL. 1970. Goose studies at Loch Leven in 1967/68. Scottish Birds 6:5–18.

A boat on the lake, or an airplane, or a short-eared owl (*Asio flammeus*) on the wing caused the whole flock of geese to fly up and circle once or twice before settling again. Otherwise, the birds were initially rather tame toward people until they had been shot at, a few days after arriving at the lake. During a 6 week hunting season between October and January, geese were much disturbed, but fewer than 200 were killed, a negligible proportion of the total population. After some shoots the abundance of geese declined, and after others it rose, so shooting probably had no important effect on the numbers of geese on the lake this winter. The same conclusion may not have been applicable for smaller waters or where disturbance was greater. The pink-footed goose (*Anser brachyrhynchus*) is more wary, difficult to shoot, and more easily disturbed than the graylag goose (*A. anser*).

144. NEWTON, I., V. M. THOM, AND W. BROTHERSTON. 1973. Behavior and distribution of wild geese in south-east Scotland. Wildfowl 24:111–121.

Shooting and other disturbance had less effect on geese on large waters than on geese on small ones. On large lakes, the abundance of geese seemed unaffected after shoots, but geese frequently deserted small waters for several days. Having been shot at, pink-footed geese (*Anser brachyrhynchus*) more often deserted a roost than did graylag geese (*A. anser*). When heavily disturbed, both species delayed arrival at roosts until well after dark and foraged extensively by moonlight. If disturbance was minimal in foraging sites, birds almost always roosted nearby. Several attributes make a site safe and acceptable for roosting, namely, absence of disturbance, size of area, openness, and distance from centers of human activity. Dupplin Lake, for example, was unattractive because of its small size and woodland setting, but was rarely disturbed and at times more geese were on it than in any other site in Britain. Disturbances were, in order of importance, low flying aircraft, gunfire, human presence, and unfamiliar and prominent objects like oil drums and scarecrows.

145. OGILVIE, M. A. 1968. The numbers and distribution of the European white-fronted goose in Britain. Bird Study 15:2–15.

The Taw-Torridge Estuary, the Towyn-Laugharne Marshes, and other haunts, notably the Burry Inlet and in the Severn and Camlad valleys near Welshpool, remain suitable habitats for greater white-fronted geese (*Anser albifrons*) and may again attract the birds if disturbance of military airfields and other sources ceases. Other than protection from disturbance of roosts and feeding-grounds, which increased the abundance of birds in some sites such as in the Avon valley, little is known of how to improve habitats for geese.

146. Ogilvie, M. A. 1981. The mute swan in Britain, 1978. Bird Study 28:87–106.

The increase in the numbers of flooded gravel pits is an obvious feature of many river valleys in the southern half of England. Mute swans (*Cygnus olor*) have colonized many where water sports have not kept them away. Pleasure boating has increased tremendously on many rivers and canals in recent years and destroyed underwater weed growth and the security of many resting places of mute swans Lead poisoning is a recent major cause of mortality of mute swans on certain Midlands rivers, such as the Trent and the Avon, where almost every dead mute swan had ingested lead weights discarded by anglers.

147. Ogilvie, M. A., and G. V. T. Mathews. 1969. Brent geese, mudflats and man. Wildfowl 20:119–125.

This paper covers the decline of brants (*Branta bernicla*), control of hunting, habitat conservation, total world population, human caused changes of the landscape, and so on. Considerable discussion focuses on the adverse effects of disturbance from an airport. The authors believe the future of brants is in doubt because of various human caused changes.

148. Oplinger, C. S. 1977. Waterfowl populations and water quality relationships in the Allentown park system. Pennsylvania Urban Observatory, City of Allentown. 221 pp.

Human disturbance of nests was not believed to be significant. However, the investigator's visits, although infrequent and conducted so as to cause as little disturbance as possible, may have caused some birds to abandon their nests. Possible predators in an urban setting are dogs and cats that catch young birds who stray too far from water. Park visitors who handle ducklings may have separated young from the rest of the brood and caused their abandonment.

149. Owen, M. 1972. Movements and feeding ecology of white-fronted geese at the New Grounds, Slimbridge. Journal of Applied Ecology 9:385–398.

Greater white-fronted geese (*Anser albifrons*) preferred fields isolated from disturbance and used other fields roughly by size and distance from areas of human activity. Droppings in forty 3-m^2 quadrats along a single transect were used to analyze the effects of disturbance. Wild greater white-fronted geese normally do not use small fields with high hedges or graze under trees. For the purposes of discussion, Owen considers such features a disturbance factor and as active disturbance which causes greater white-fronted geese to flee. Owen also discusses directional and non-directional disturbances. Low-flying aircraft and hunters have a marked effect on greater white-fronted geese. Owen believes the profoundest disturbances are directional and usually arise from human activity; noise is not as disturbing as sightings of moving objects, and fields that are screened from canals or roads by a belt of trees are not as disturbed as fields without screens. Owen concludes that, if all disturbance were removed from the New Grounds, the potential carrying capacity more than doubles and that nothing affects wintering greater white-fronted geese as profoundly as disturbances.

150. Owen, M. 1972. Some factors affecting food intake and selection in white-fronted geese. Journal of Animal Ecology 41:79–92.

Greater white-fronted geese (*Anser albifrons*) in quarries are less wary after the end of the shooting season and tolerate much more disturbance when food is scare, even if they have to dedicate more time to vigilance. Wariness of a flock of foraging greater white-fronted geese may depend on traditional disturbance and novel disturbances. On average, geese expend 3% of their time in vigilance and parents expend more time in vigilance than others, thus, allowing young birds to forage or rest longer. Level of disturbance determines time for foraging, which is shortened when birds are frightened and fly up. During the short daytime of midwinter, greater white-fronted geese graze during more than 90% of daytime and spend the remaining daylight hours in other essential activities such as drinking, preening, and flight from disturbance. Disturbances compel birds to feed at night, possibly lose weight, and desert the feeding area.

151. OWEN, M. 1973. The management of grassland areas for wintering geese. Wildfowl 24:123–130.

Disturbance controls wintering geese more than availability of food. Heavy shooting keeps geese away from favorable habitat. Riders are less disturbing and sometimes can approach geese to within 46 m. Helicopters are extremely disturbing, and low-flying, small planes can cause geese to fly to roosts or refuges. Barnacle geese (*Branta leucopsis*) at Caerlaverock were sometimes raised by small aircraft at a distance of 1.6–3.2 km. Even brants (*B. bernicla*) become indifferent to larger planes. Noise is less disturbing than visual cues, but sudden sounds usually disturb geese. Greater white-fronted geese (*Anser albifrons*) expend about 3% of their undisturbed time in vigilance, but forced increase of vigilance takes time away from foraging. Avoidance of disturbance was estimated for geese on 47 fields at Slimbridge by giving arbitrary points for distance from roost (0–2), size of field (0–20), extent of hedges or banks (0–5), shepherding frequency (0–15), distance from roads or canals (0–10), distance of bordering roads or canals from field center (0–30). The sum of the avoidance values by field plotted against mean use by geese in four seasons indicated that the higher the sum of the avoidance values was, the lower was the use of fields by geese ($P = 0.1$). Greater white-fronted geese can spend more than 2% of their daytime drinking. If water is not freely available, birds have to fly to drink and bathe. Pink-footed geese (*A. brachyrhynchus*) at Loch Leven travelled several miles to the roost at midday to drink. Geese relying on food of low nutritive value cannot afford such an expenditure of time and energy.

152. OWEN, M. 1973. The winter feeding ecology of widgeon at Bridgwater Bay, Somerset. Ibis 115:227–243.

Eurasian wigeons (*Anas penelope*) are very wary and disturbance profoundly affects their foraging behavior. Owen used Fenning Island, a peninsula bounded by the river Parrett estuary on one side, by a shingle ridge on the seaward side, and by an observation tower and farm access on the third (landward) side, to calculate an index to disturbance (no. 151). Disturbance from the landward and seaward side is profound, but light on the estuary bank. Consequently, Owen used the combined distance from the center of each plot to the shingle ridge and to the observation tower as a measure of the magnitude of the disturbing influence. Owen expected that differences between plots where droppings were counted correlate with distance from disturbance. He found that the density of droppings increased as the distance from disturbance increased (+0.496 [n. s.] in 1968–69; +0.817 [$P < 0.01$] in 1969–70; and +0.325 [n. s.] in 1970–71). Owen included landscape factors in his calculations.

153. OWEN, M. 1976. Factors affecting the distribution of geese in the British Isles. Wildfowl 27:143–147.

Availability of habitat and food are believed to be the most important factors influencing the presence of geese (greater white-fronted geese [*Anser albifrons*], graylag geese [*A. anser*], pink-footed geese, [*A. brachyrhynchus*], bean geese [*A. fabilis*], brants [*Branta bernicla*], and barnacle geese [*B. leucopsis*]) and their past distribution. Both continue to be altered with changes in disturbance and agriculture and with various types of development. Past creation of open areas by forest clearance was undoubtedly to the benefit of geese. Other changes, such as increasing restrictions on shooting seasons, loss of interest in hunting and egg collecting because of improvements in human diets, and creation of refuges have more than doubled the numbers of four species of geese in the last 20 years.

154. OWEN, M., AND G. WILLIAMS. 1976. Winter distribution and habitat requirements of widgeon in Britain. Wildfowl 27:83–90.

Large sites afforded greater security from disturbance. On mudflats, feeding is controlled by the tide. Elsewhere, wigeons feed by day in undisturbed areas, but spend the day on the roost when feeding grounds are subjected to daytime disturbance. Drainage with its consequent disturbance and increases in recreational activities, particularly birdwatching, accelerated the decline of Eurasian wigeons. Bird counters responded to a questionnaire by listing factors they considered important threats to Eurasian wigeons (*Anas penelope*). Listed factors and their frequencies (in parentheses) were shooting (37), boating and sailing (28), fishing (18), birdwatching (9), powerboating and water skiing (6), pleasure flying (2), other recreational activities (13) under recreation; and industrial development (31), drainage (20), reclamation (12), military activities (4), bird scaring (2) under commercial-development.

155. OWENS, N. W. 1976. Responses of wintering brent geese to human disturbance. Wildfowl 27:152.

Effects of human disturbance on distribution and behavior of wintering brants (*Branta bernicla bernicla*) in Essex were assessed. Brant avoided disturbed areas and places with poor visibility in early winter, but used them later when favored areas became depleted of food. Brants became partially habituated to the proximity of people and to some loud noises, but did not habituate to small, low-flying aircraft. Disturbance could be ameliorated or reduced by restricting access of people to the sea wall in certain areas around high tide and by controlling low-flying aircraft in the area.

156. OWENS, N. W. 1977. Responses of wintering brent geese to human disturbance. Wildfowl 28:5–14.

Large boats and yachts rarely disturbed brant (*Branta bernicla*), but small boats with noisy outboards caused them to fly. In 168 h of observation, human disturbance caused some birds to fly an average of once every 81 min. Forty-eight percent of disturbances were by people, most of whom were on shore; 39% by aircraft, chiefly small planes; 9% by loud noises; and 4% by small boats. Disturbances by aircraft caused about twice as many brants to fly as disturbances by people ($d = 5.3$; $P < 0.001$). Aircraft caused about 1.6 times as much disturbance as people. Without disturbance, brants spent an average of 1.1% of their time in flight. Total time spent flying correlated with the amount of flying caused by disturbance ($r = 0.93$; $n = 11$; $P < 0.001$). Disturbances on weekends stopped brants from foraging for as much as 11.7% of their time and increased time spent flying as much as sevenfold. Overall, disturbance would probably have been unimportant if adequate food was available. However, food shortages probably prevented full compensation for disturbance.

157. PAGE, R. D., AND J. F. CASSELL. 1971. Waterfowl nesting on a railroad right-of-way in North Dakota. Journal of Wildlife Management 35:544–549.

Nesting success was calculated on the basis of 80 of 85 nests. Of five nests not included, four were abandoned and one was destroyed by a search vehicle. These desertions were attributed to search operations.

158. PARR, D. 1974. The effect on wildfowl of sailing at Island Barn Reservoir. Surrey Bird Report 1973:74–78.

Sailing and waterfowl do not mix well. As sailing takes over the entire water surface, birds are constantly harassed. Birds leaving the reservoir fly chiefly to the Queen Elizabeth II Reservoir. Despite disturbance on sailing days, birds quickly return to the Island Barn Reservoir on non-sailing days as confirmed by Saturday and mid-week counts during 1972–73 and 1973–74. Sometimes fewer waterfowl return than were chased off. The Queen Elizabeth II Reservoir is less than a mile from Island Barn Reservoir and clearly the maintenance of the former as an undisturbed sanctuary is important for maintaining the abundance of ducks at the Island Barn Reservoir. Mallard (*Anas platyrhynchos*) seem to be generally tolerant to sailboats. The abundance of green-winged teals (*A. crecca*) in the post-sailing period has declined by one-half. The effect of sailing on tufted duck (*Aythya fuligula*) seems to have been largely on the numbers of molting birds, which increased on some reservoirs in August. Numbers in mid-winter have not been appreciably affected. However, in response to sailboats, common goldeneyes (*Bucephala clangula*) have almost deserted the reservoir.

159. PARR, D. E., M. D. SCOTT, AND D. D. KENNEDY. 1979. Autumn movements and habitat use by wood ducks in southern Illinois. Journal of Wildlife Management 43:102–108.

The two roosts at Union County Refuge were not subjected to direct hunting, and the northern roost at the LaRue–Pine Hills Ecological Area was closed to hunting each noon. These roosts supported large populations of wood ducks (*Aix sponsa*) during hunting seasons. Wood ducks from the northern roost at the LaRue–Pine Hills Ecological Area were harvested by hunters at the Oakwood Bottoms Greentree Reservoir until the birds migrated from the area. The area around the Union County Refuge was not hunted as intensively for wood ducks, but birds moving from these roosts were game for hunters. Thus, by establishing refuges for roosting, populations of wood ducks can be retained during the hunting season to provide continuous, legal game in surrounding areas. The opposite assumption is that hunting drives wood ducks from an area.

160. PARRY, M. L. 1987. Multi-purpose use of waters. Pages 66–71 *in* P. S. Maitland and A. K. Turner. Angling and wildlife in freshwaters. Proceedings of a symposium organized by the Scottish Freshwater Group and the British Ecological Society. University of Stirling, 30 October 1985. (ITE Symposium 19)

This is a general summary of some human disturbances to waterfowl and descriptions of the use and conflicts at several reservoirs as examples. Key words are roosting or feeding waterfowl, birdwatchers, water-based recreation, boating, time-zoning of use, space zoning, refuge, flight, energetic costs, anglers, waterfowl counts, scare distance for mallards (*Anas platyrynchos)*, and compensatory conservation.

161. PAULUS, S. L. 1984. Activity budgets of nonbreeding gadwalls in Louisiana. Journal of Wildlife Management 48:371–380.

Gadwalls (*Anas strepera*) rarely left foraging sites during day or night except when disturbed or during hunting season. Hunting in marshes around the Rockefeller Refuge forced many gadwalls to leave these marshes during the day and use impounded marshes on the refuge.

162. PEDROLI, J-C. 1983. Activity and time budget of tufted ducks on Swiss lakes during winter. Wildfowl 33:105–112.

When ice covered the bird sanctuary, tufted ducks (*Aythya fuligula*) sometimes rested on open water near Neuchâtel, the feeding ground of the Bas-lac region. Boat traffic for hunting, fishing, and sport was dense and produced major disturbances. Disturbances were similar in Vaumarcus and Yvonand, but considerably greater than in the bird sanctuary. Boat traffic was again the main source of disturbance. Frequent storms forced anglers to take in their nets at night, which greatly disturbed feeding ducks. These nocturnal disturbances were probably responsible for the decrease in the number of birds in the Bas-lac region. The duration of foraging was more or less constant throughout winter and the only increase was between the end of November and the end of December when boat traffic on the lake increased disturbance and flights that cost energy. On Lake Neuchâtel, the foraging site with the least disturbance was occupied first with the greatest number of wintering ducks. Movement of ducks toward other foraging sites was caused by disturbance at night.

163. PFEIFER, W. K., AND S. D. FAIRAIZL. 1988. Should ducks be frightened? Pages 160–162 *in* D. W. Uresk, G. L. Schenbeck, and R. Cefkin, technical coordinators. Eighth Great Plains Wildlife Damage Control Workshop Proceedings. U.S. Forest Service General Technical Report RM-154.

Commonly waterfowl depredations of small grains cease in response to mechanical scare devices or pyrotechnics. Such scaring can cause waterfowl to damage by trampling up to twice the amount of consumed grain. A combination of conditions such as weather, harvest stage, cultural techniques, farm equipment, length of damage season, availability of alternative feeding sites, and waterfowl population may increase losses from trampling and should be evaluated to determine whether large-scale scaring actually increases damage to small grains. Many scare devices were built, collected, and distributed throughout the state, including propane exploders, black plastic flags, firearms, 15-mm flare pistols, racket bombs, whistle bombs, noise bombs, cracker shells, and M-80 type bird bombs.

164. PIEST, L. A., AND L. K. SOWLS. 1985. Breeding duck use of a sewage marsh in Arizona. Journal of Wildlife Management 49:580–585.

Nests that were deserted (2.8%), apparently because of disturbance were excluded from the authors' sample.

165. PREVETT, J. P., AND C. D. MACINNES. 1980. Family and other social groups in snow geese. Wildlife Monograph 71, The Wildlife Society, Washington, D.C. 46 pp.

When feeding or loafing snow geese (*Chen caerulescens*) were frightened suddenly, entire flocks took off in near unison without normal preflight coordination of families. If flocks were large, birds rose in a confused, clamoring mass and social groups frequently were broken in the disorder. Flocks of snow geese frightened by the same disturbance mixed while circling before landing again. Disturbances that caused flocks to flush were more frequent in northern states than on the Gulf Coast. Sources of profound disturbances were eagles on the wing, aircraft, and nearby human activity. The reported observations were from protected areas; however, gunfire on refuge boundaries sometimes frightened snow geese inside the refuge. Some geese that flew outside the refuge to feed came under heavy fire that caused flocks to separate and scatter.

166. PURDY, K. G., G. R. GOFF, D. J. DECKER, G. A. POMERANTZ, AND N. A. CONNELLY. 1987. A guide to managing human activity on National Wildlife Refuges. Human Dimensions Research Unit, Department of Natural Resources, Cornell University, Ithaca, New York; U.S. Fish and Wildlife Service, Fort Collins, Colo. 57 pp.

Various disturbances of 20 species of wildlife were reported by managers of 16 wildlife refuges in Region 5, including: shorebirds (61.5%), waterfowl (16.9%), great blue herons (*Ardea herodias*) (12.8%), deer (*Odocoileus* spp.) (5.4%), eastern bluebirds (*Sialia sialis*) (2.0%), loggerhead turtles (*Caretta caretta*) (1.4%), and herons (0.7%). Disturbances (148 instances) varied by species and by refuge, but most often (41.3%) lowered reproduction, and caused aberrant behavior or stress (16.2%), reduced use of apparently preferred refuge habitat (13.5%) and use of refuge (12.8%), and caused direct mortality (11.5%) and indirect mortality (4.7). Refuge manager's perception of the importance of disturbances by species was shorebirds (73%), waterfowl (17%), birds of prey (16%), deer (5%), bluebirds and herons (no data), and loggerhead turtles (2%). Overall, managers considered disturbances of great importance 58.5% of the time, of moderate importance 22.1%, and of minor importance only 19.5% of the time. Exploring on foot was involved in 48.0% of the disturbances, and driving on beaches was involved in 20.9% of the disturbances. In 83% of the 16 refuges, direct mortality was from hunting, and in 50% it was from driving on roads. In 100% of the 16, indirect mortality was from feeding or petting; lowered productivity was from harassing wildlife, collecting eggs, and littering. In 50% of the 16, reduced use of the refuge was from hiking–bicycling–jogging and sunbathing–swimming. Reduced use of preferred habitat was from exploring on foot in 18% and from hunting in 17% of the refuges. Aberrant behavior and stress was from feeding–petting in 50% and from wildlife observation on foot in 29% of the refuges.

167. RAVELING, D. G. 1979. Traditional use of migration and winter roost sites by Canada

geese. Journal of Wildlife Management 43:229–235.

Temporary separation of family members was common in response to human disturbances by roosting and foraging Canada geese (*Branta canadensis*). These separations may account for most of the differences between fidelity of adults and immatures to roost locations. Young birds apparently did not return to traditional roost sites as rapidly as adults. Intentional harassment or hazing of Canada geese by wildlife agencies resulted in accelerated kill by hunters in a short time and has not been successful in inducing desired migration. Repeated flushing prevents birds from establishing or returning to traditional roost sites and continually disrupts the family and social structure. Canada geese are probably highly vulnerable to hunting because they seek to reestablish contact with their parents and siblings. The author believes that hazing is ineffective and an inhumane technique of inducing migration and, furthermore, calls into question the use of the word refuge.

168. REED, A. 1975. Reproductive output of black ducks in the St. Lawrence Estuary. Journal of Wildlife Management 39:243–255.

Fifty-two of 98 abandoned nests of American black ducks (*Anas rubripes*) were abandoned in response to the author's interference. However, capturing and marking of nesting females during only late incubation did not seem to contribute appreciably to loss of nests. On Ile-aux-Pommes, the losses were largely attributed to predators such as gulls (*Larus* sp.), and occasionally American crows (*Corvus brachyrhynchos*), or to nest-site competitors such as common eiders (*Somateria mollissima*), which occasionally take over nests of American black ducks. On the mainland where the red fox (*Vulpes fulva*) and the American crow are the chief predators, human scent and disturbed vegetation may have raised observer-induced losses, more than on the island.

169. REEVES, H. M., H. H. DILL, AND A. S. HAWKINS. 1968. A case study in Canada goose management: the Mississippi Valley population. Pages 149–165 *in* R. L. Hine and C. Schoenfeld, editors. Canada goose management, current continental problems and programs, a symposium. Dembar Educational Research Services, Inc., Madison, Wis.

Hazing at the Horicon National Wildlife Refuge was vigorous. At the peak of hazing during the week prior to the hunting season, one helicopter, two fixed wing aircraft, two airboats, two marsh vehicles, six conventional boats, 15 floating platforms mounted with exploders, 16 landbased exploders, and other frightening devices such as shot-shells and firecrackers were employed by 39 individuals. Hazing was discontinued 24 h before the opening of the hunting season. Hazing removed most Canada geese (*Branta canadensis*) from the refuge during daylight hours, but the geese returned at dusk. Hazing, as conducted, failed to reduce migration of Canada geese to more southern areas, but seemed to break up family groups and made them more vulnerable to hunters.

170. REICHHOLF, J. 1970. Der Einfluβ von Störungen durch Angler auf den Entenbrutbestand auf den Altwässern am Unteren Inn. (The influence of disturbance by anglers on duck reproduction in backwaters of the Lower River Inn) Die Vogelwelt 91:68–72.

The 85% decrease of breeding ducks since 1961 at two 1-ha ponds near the reservoir of Egglfing by the River Inn was presumably caused solely by disturbance from an increasing number of anglers during the breeding season. Numbers of northern shovelers (*Anas clypeata*), green-winged teals (*A. crecca*), mallards (*A. platyrhynchos*), common pochards (*Aythya ferina*), and tufted ducks (*A. fuligula*) decreased from 26 pairs with 134 ducklings in 1961 to 4 pairs with 19 ducklings in 1969. Surface-feeding ducks have vanished completely from the area. Food plants did not change in this period. A limitation on angling is urgently needed to protect breeding ducks.

171. REICHHOLF, J. 1976. The influence of recreation activities on waterfowl. Pages 364–369 *in*

M. Smart, editor. Proceedings of the international conference on conservation of wetlands and waterfowl, Heiligenhafen, Federal Republic of Germany, 2–6 December 1974. International Waterfowl Research Bureau, Slimbridge (Glos), England.

During the waterfowl breeding season, anglers can cause a serious decline in breeding waterfowl. One study revealed a 90% decrease during 10 years. One angler may prevent ducks from establishing territories or selecting nest sites when the area of open water is less than 1 ha. Disturbance is less of a problem on larger waters. Intensive angling reduced the expected number of waterfowl nests by 80%, and nests were only found in areas inaccessible to anglers. Breeding success is also much lower in areas with anglers and boaters because of losses of clutches to crows (*Corvus* sp.) and black-billed magpies (*Pica pica*). Also, the motor boat's bow wave tips over exposed nests. Hunters who shoot nests of crows and black-billed magpies in May to reduce predation by these birds on clutches of waterfowl have an effect other than intended effect. Flocks of non-breeding crows take over the empty territories. Existing sanctuaries could provide legislatively created vital reserves for molting birds, but instead, steadily increase disturbances from recreation. Extensive hunting in August–September prevents an influx of ducks, greatly reduces efficient foraging of waterfowl in wetlands, and prevents formation of anaerobic muds. The author recommends restrictions for angling, establishment of protected sites for molting birds, and no hunting or boating in some wetlands until completion of further studies of the effects of recreation on waterfowl.

172. RIGGERT, T. L. 1977. The biology of the mountain duck on Rottnest Island, Western Australia. Wildlife Monograph 52, The Wildlife Society, Washington, D.C. 67 pp.

Both the silver gull (*Larus novaeholandiae*) and the Australian raven (*Corvus coronoides*) prey on nests of mountain ducks (*Tadorna tadornoides*) on Rottnest Island, and the presence of investigators is expected to have attracted the predators to nesting burrows. The author believes predators were searching for food scraps and inadvertently discovered duck nests.

173. ROBERTS, E. L. 1966. Movements and flock behavior of barnacle geese on the Solway Firth. Annual Report, The Wildfowl Trust 17:36–45.

Barnacle geese (*Branta leucopsis*) react most often to passing aircraft, moderately often to humans, and least often to other birds and livestock. Barnacle geese forage almost all day. Close observation of wintering flocks at Caerlaverock for one complete winter resulted in 203 witnessed disturbances of the flock: 71 by aircraft (35%), 33 by people on the ground (16.2%), 15 by other birds (7.3%), 3 by livestock (1.5%), and 81 by unknown sources (40%).

174. ROSS, R. K. 1984. Migrant waterfowl use of the major shorelines of eastern Ontario. Pages 53–62 *in* S. G. Curtis, D. G. Dennis, and H. Boyd, editors. Waterfowl studies in Ontario, 1973–81. Canadian Wildlife Service Occasional Paper 54.

Waterfowl distribution is related to agricultural practices, urbanization, hunting, sanctuary areas, and feeding. The Cessna Skymaster's fast speed undoubtedly reduces survey efficiency because observers miss birds, but a slower-moving, noisier aircraft (Beaver) gives waterfowl earlier warning and may cause birds to flush so far in advance that observers miss or misidentify them. Most observed waterfowl were diving ducks. Of these, the bay ducks (*Aythya* spp.), bufflehead (*Bucephala albeola*), common goldeneye (*B. clangula*), and mergansers (*Mergus* spp.) were easy to see from the air because of their tendency to form highly visible flocks, preference for shallow water, and relatively minor reactions to low-flying aircraft. Long-tailed ducks (*Clangula hyemalis*) often dove before the aircraft reached them, further lowering counts. Boat traffic tends to disturb rafting birds and thus reduces feeding efficiency. Only in winter may ducks benefit from boat traffic proposed for the Seaway because freighters and ice breakers create open water for feeding.

175. RUSCH, D. H., S. R. CRAVEN, R. E. TROST, J. R. CARY, R. L. DRIESLEIN, J. W. ELLIS, AND J. WETZEL. 1985. Evaluation of efforts to redistribute Canada geese. Transactions of the North American Wildlife and Natural Resources Conference 50:506–524.

In the early 1960's, counts of Canada geese (*Branta canadensis*) at Horicon National Wildlife Refuge in fall reached 100,000 and increased annually. Management dumped 475,003 kg (467.5 tons) of shelled corn to hold Canada geese on the refuge in 1965, but crop depredations were high nevertheless. In 1966, an effort to disperse Canada geese by aircraft failed because of lack of cooperation between state and federal agencies. In late October, a helicopter that operated only over the refuge also flushed geese from adjacent private lands at a distance of up to 2 km (1.24 miles). Because they could be operated after dark, airboats were effective and versatile for hazing Canada geese. Canada geese were highly sensitive to a low-flying helicopter, but it could not be used after dark. Although Canada geese loafed in uplands during the day, thousands returned during the 2 h after sunset in 1966. Disruption of night roosting with airboats was successful in 1976–78. Propane exploders were largely ineffective, but frequent use of airboats for the maintenance of the exploders created a major disturbance.

176. SHERWOOD, G. A. 1965. Canada geese of the Seney National Wildlife Refuge. Completion Report for Wildlife Management Studies 1 and 2., Seney National Wildlife Refuge, Seney, Michigan. U.S. Fish and Wildlife Service, Region 3, Minneapolis, Minn. 222 pp.

Family ties of Canada geese (*Branta canadensis*) are fragile during the first 3–4 weeks of life, and a brood unit could be easily broken up. Vehicles on dikes surprised broods, caused them to panic, and dispersed them in all directions. Parents usually headed for the pool, but some goslings were lost in dense vegetation. Parent's usually swam off without goslings that could not follow. Occasionally, the gander waited for a straggler if he heard its call. Because of its disruptive nature, driving the refuge dikes was kept to a minimum.

177. SINCOCK, J. R. 1966. Back Bay - Currituck Sound data report. Waterfowl studies, Vol. 2. U.S. Fish and Wildlife Service, Patuxent Wildlife Research Center, Laurel, Md. 62 pp.

Disturbance affected use of foraging sites by diving ducks (*Aythya* spp.) more than use of foraging sites by dabbling ducks (*Anas* spp). Disturbance was the primary factor that kept diving ducks from using foraging sites. Use by diving ducks of foraging sites with good food and high disturbance was highest in the post-hunting season and less than average during the hunting season. This differs from high use by diving ducks of foraging sites in natural or established sanctuaries during the hunting season and sharply reduced use of such areas by diving ducks after the hunting season. Data suggest that diving ducks have low tolerance of disturbance. When disturbance was above average, Canada geese (*Brant canadensis*) used only one area with above average frequency—probably because of heavy baiting. The only other areas with above average use by Canada geese during the hunting season in either year were in the refuge or in the sanctuary or where disturbance was low. Disturbance of Canada geese on the Back Bay–Currituck Sound is definitely affected by disturbance. Use of the entire area by dabbling ducks and American coots (*Fulica americana*) apparently was about equally affected by food conditions and disturbance.

178. SMITH, A. G. 1971. Ecological factors affecting waterfowl production in the Alberta parklands. U.S. Fish and Wildlife Service Resource Publication 98. 49 pp.

Brood censuses were conducted in the same manner as breeding pair censuses. When disturbed, young of northern pintail (*Anas acuta*) and mallard (*A. platyrhynchos*) tended to run for upland cover. The effects of humans on nesting success by ducks was probably somewhat greater than indicated by data from this study. Not only were nests deserted early in the season because the hens were disturbed by observers, but nests were also destroyed by plowing, burning of stubble and pasture lands, fence building, and road construction. Human-induced disturbances were undoubtedly responsible for many unobserved losses before research began in the spring. A brood census is a disturbance and a local waterfowl population may take several days to recover from it. The disturbance from the observer's activities was not fully understood, but caused females and their broods to go overland and may have raised mortality from avian predators, mammalian predators, automobiles on highways, and physical exhaustion.

179. Steel, P. E., P. D. Dalke, and E. G. Bizeau. 1956. Duck production at Gray's Lake, Idaho, 1949–1951. Journal of Wildlife Management 20:279–285.

The authors describe sampling of over-water nests of diving ducks (*Aythya* spp.). The nests were located by flushing the hens. The hens flushed upon the approach of the researchers' boat, which had an outboard motor. The authors do not mention whether the use of the boat, which was operated at different speeds and for different lengths of time, was responsible for the desertion of nests by hens. Twenty-eight of 147 unsuccessful clutches were deserted.

180. Sterling, T., and A. Dzubin. 1967. Canada goose molt migrations to the Northwest Territories. Transactions of the North American Wildlife and Natural Resources Conference 32:355–373.

Authors concluded that banding and boating caused some groups of molting Canada geese (*Branta canadensis*) to desert sites. They suggested that presently known molting grounds be given added protection from human intrusion by boat and airplane from 15 June to 1 August. These recommendations were made in view of increasing oil exploration, mining, tourism, canoeing, and angling in northern Canada.

181. Stieglitz, W. O., and C. T. Wilson. 1968. Breeding biology of the Florida duck. Journal of Wildlife Management 32:921–934.

Of 21 lost clutches of Florida ducks, (mallards, *Anas platyrhynchos fulvigula*) 10 (47.6%) were lost to unknown causes. The eggs had disappeared from most nests, but the nests were not disrupted and no egg shells were in the vicinity of the nests. Such predation could logically be attributed to snakes, humans, or fish crows (*Corvus ossifragus*). Because some of the spoil islands are frequently visited by anglers, boaters, and picnickers, and because the snake population is low and humans readily collect eggs, most of the unknown losses were attributed to humans.

182. Stotts, V. D., and D. E. Davis. 1960. The black duck in the Chesapeake Bay of Maryland: breeding behavior and biology. Chesapeake Science 1:127–154.

Males or pairs of American black ducks (*Anas rubripes*) disturbed by the observer usually flew a short distance offshore and returned soon after the observer withdrew. If disturbed just prior to nesting, the pair flew off while the female quacked loudly and never returned to nest at that exact area. Nest-building females often flushed within 91.4 m (100 yards) of an investigator and usually never returned. In 1956, 22 nesting females were trapped on their nests and marked. Six of them deserted their nests because of flooding or observer interference, 1 lost her nest to crows (*Corvus* sp.), and 13 hatched clutches. In 1954, collection of many clutches by the researchers caused desertion of many nests by the hens, and unusual activity near nests may have caused predation by crows. In 1955, local residents collected many clutches of eggs from Bodkin Island. Hens abandoned 4 of 574 nests because of humans, and 132 specifically because of the observer (a total of 3.3% of all nest losses); 12 nests were destroyed by other humans.

183. Strang, C. A. 1980. Incidence of avian predators near people searching for waterfowl nests. Journal of Wildlife Management 44:220–222.

This paper raises questions about work by MacInnes and Misra (1972) and Mickelson (1975). The author states, "Waterfowl biologists collecting nest data in tundra regions often have the impression that they are being followed by avian predators, such as gulls and jaegers (MacInnes and Misra 1972)." He then reported his observations of long-tailed jaegers (*Stercorarius longicaudus*), parasitic jaegers (*S. parasiticus*), and glaucous gulls (*Larus hyperboreus*), in the Clarence Rhodes National Wildlife Range in Alaska. He ended with the statement, "I conclude that there is still a need for estimation of the undisturbed losses of waterfowl eggs to predators." MacInnes' response is in the same volume of the *Journal of Wildlife Management* (no. 124).

184. SUGDEN, L. G., W. J. THURLOW, R. D. HARRIS, AND K. VERMEER. 1974. Investigation of mallards overwintering at Calgary, Alberta. Canadian Field-Naturalist 88:303–311.

Available food, open water, and protection from hunting were considered chief factors causing mallards (*Anas platyrhynchos*) to forego migration. Of the techniques tried to induce migration—no supplementary feeding, removal by transfer, scaring with acetylene exploders, and winter shooting within the city—cessation of feeding was most acceptable and efficient.

185. TAKEKAWA, J. Y. 1987. Energetics of canvasbacks staging on an Upper Mississippi River pool during migration. Ph.D. thesis, Iowa State University, Ames. 189 pp.

Canvasbacks (*Aythya valisineria*) reacted to human activity by alert posturing, swimming, diving, or usually by flying. The percentage of time that canvasbacks were disturbed varied weekly, but most disturbances of canvasbacks occurred during the first 2 weeks of fall. Scan samples for time-activity budgets were based on observations of ducks sitting on the water, thus percentages reported for disturbance (0.6%) may be underestimated.

186. TAMISIER, A. 1985. Hunting as a key environmental parameter for the Western palearctic duck populations. Wildfowl 36:95–103.

Western Palearctic duck populations are intensively hunted from mid-July to the end of May; 10 million are killed annually; about 15 million still exist in January. A wide discrepancy exists between the very few countries that are responsible for these high mean figures because of night shooting, long hunting seasons, and heavy kill. Consequently, the winter distribution of ducks is biased in favor of the lightly hunted countries where the overall population is level. Lowering the hunting pressure to restore western palearctic duck populations must be achieved through international cooperation. Prohibiting hunting at night and shortening the hunting season—from September in the northern and eastern countries and October in the western and southern countries until the end of January—would be helpful. Protection of wetlands is fruitless as long as hunting regulations are not changed. Varying levels of hunting disturbances in various countries are discussed comprehensively.

187. THOMAS, G. 1976. Habitat usage of wintering ducks at the Ouse Washes, England. Wildfowl 27:148–152.

During the waterfowl hunting season, before January 31, mallards (*Anas platyrhynchos*) spent only 13%, and Eurasian wigeons (*Anas penelope*), only 17% of their time in non-refuge areas. After January 31, about 66% of the use days by mallards and Eurasian wigeons were on hunted land. Before January 31, mallards spent 19.6 times as many duck days per hectare and Eurasian wigeons 14.5 times as many duck days per hectare in non-refuge areas as after the close of the waterfowl hunting season. After January 31, use of refuge areas by mallards was only 1.4 times the use of non-refuge areas and by Eurasian wigeons only 2.0 times the use of non-refuge areas, indicating that disturbance from hunting was restricting birds to refuge areas. During the waterfowl hunting season, common pochards (*Aythya ferina*) were equally distributed inside and outside the refuge and used mainly nonhunted boundary rivers. After the close of the waterfowl hunting season, the common pochards used mostly areas outside the refuge.

188. THOMPSON, D. 1973. Feeding ecology of diving ducks on Keokuk Pool, Mississippi River. Journal of Wildlife Management 37:367–381.

From 1966 through 1968, relations between diving ducks (*Aythya* spp.) and their food resources on the Keokuk Pool (Pool 19) of the Mississippi River were examined. This information is useful as a baseline from which to measure the effects of channelization on food resources of diving ducks. Each year, nearly 20 million diving duck days were recorded by aerial and ground census. Night dispersal and feeding were very important to diving ducks because disturbances caused the concentration of 90% of the waterfowl on 28% of the study area during daytime. (D. Thompson is J. D. Thompson in the following thesis).

189. THOMPSON, J. D. 1969. Feeding behavior of diving ducks on Keokuk Pool, Mississippi River. M.S. thesis, Iowa State University, Ames. 79 pp.

Most hunting on the Keokuk Pool (Pool 19) was done on back-waters, but in 1967 about 25 blinds were built over open water. Flocks of diving ducks were disturbed by shooting and by movements of hunters between blinds and landing areas. The Keokuk Pool sustains a commercial fishery. Much fishing occurs during summer, but also in late spring and throughout fall when trot-lines and trammel nets are fatal to diving waterfowl which become entangled in them. Fishing disturbs large flocks of diving ducks and flushes them from one section of the pool to another. In fall, the highest disturbance was in the upper section of the pool where the abundance of birds was lowest. Many birds foraged until disturbed by hunters, anglers, or barges. If disturbance continued throughout the day, waterfowl concentrated on the lower section of the pool where disturbance was the least. The lower section, particularly the area with the greatest percentage of diving ducks during the day, became depleted of food if large flocks fed there.

190. THORNBURG, D. D. 1973. Diving duck movements on Keokuk Pool, Mississippi River. Journal of Wildlife Management 37:382–389.

In 1969, patterns and causes of local movements of diving ducks on the Keokuk Pool (Pool 19) of the Upper Mississippi River in response to hunter harvest and food availability were examined. Within a week of arrival, diving ducks on the Keokuk Pool established a diurnal rhythm of movement. At dawn, the ducks flew from the highly disturbed middle and upper sections to the less disturbed lower section where they loafed throughout the day. At dusk, the birds returned upstream to choice feeding areas in the middle and upper sections. Over 60% of the population on the pool participated in this daily movement and human disturbance was the major cause for these mass movements. Hunting was most intense in the middle and upper sections and the initiation of mass movements to the lower segment correlated with the opening of the hunting season. Birds foraged minimally on the pool during the day, but foraged extensively at night in the middle and upper sections of the pool. The middle and upper sections had more bottom invertebrates than the lower section. The distribution of diving ducks correlated with the greatest abundance of benthic organisms.

191. TUITE, C. H., M. OWEN, AND D. PAYNTER. 1983. Interaction between wildfowl and recreation at Llangorse Lake and Talybont Reservoir, South Wales. Wildfowl 34:48–63.

Recreation decreased during autumn and increased in March. Boats were very dispersed throughout different parts of the lake. The authors concluded that recreation was responsible for significantly limiting the carrying capacity of Llangorse Lake for wintering waterfowl. Prohibiting recreation in key areas would probably increase the abundance and diversity of wildfowl, but would require an overall decrease of recreation in summer. In winter, boats would have to be excluded from about a quarter of the lake area. This should not substantially affect the quality of winter recreation. Birdwatching is the most widespread single form of recreation on British inland waters in summer and winter. Some compromise with birdwatchers should be reached at Llangorse Lake which is so important to both recreation and wildlife.

192. TUITE, C. H., P. R. HANSON, AND M. OWEN. 1984. Some ecological factors affecting winter wildfowl distribution on inland waters in England and Wales, and the influence of water-

based recreation. Journal of Applied Ecology 21:41–62.

Multiple regression analyses were used to compare distributions of nine common species of waterfowl in Britain with six independent variables of the ecology in inland waters. Large sites tended to hold more waterfowl than smaller sites. Waterfowl used bodies of water with convoluted shorelines more than those with straight shorelines, because many large reservoirs are primarily roosts that have relatively simple shorelines. Chi-square analyses were used to examine the observed number of birds by different water-based recreation. Species most susceptible to disturbance from recreation were northern shovelers (*Anas clypeata*), green-winged teals (*A. crecca*), and common goldeneyes (*Bucephala clangula*). Most tolerant were mallards (*A. platyrhynchos*), common pochards (*Aythya ferina*), tufted ducks (*A. fuligula*), and mute swans (*Cygnus olor*). Coarse fishing, sailing, and rowing reduced the abundance of wildfowl in winter the most. The presence of birdwatchers was associated with higher-than-expected numbers of most species.

193. TYDEMAN, C. F. 1977. The importance of the close fishing season to breeding bird communities. Journal of Environmental Management 5:289–296.

Breeding bird populations of three gravel pits were studied for 2 years. Fishing during the close season is an important factor in determining the composition of bird communities and actual numbers of nesting pairs. The harm of close season fishing seems to be largely indirect—general disturbance and denudation of the bank vegetation. The author recommended that close fishing season be prohibited wherever possible and carefully controlled where complete prohibition is not practicable, chiefly for the sake of the birds.

194. U.S. FISH AND WILDLIFE SERVICE. 1976. Environmental impact assessment: effect of boating on management of Ruby Lake National Wildlife Refuge. Portland, Oreg.

After boating was allowed on Ruby Lake National Wildlife Refuge, nesting success by redheads (*Aythya americana*) dropped from 92% to 83% and from 91% to 57% by canvasbacks (*Aythya valisineria*). Nesting success by both species in control areas remained relatively high.

195. U.S. FISH AND WILDLIFE SERVICE. 1987. Migratory nongame birds of management concern in the United States: the 1987 list. Office of Migratory Bird Management, Washington, D.C. 27 pp. + app.

From a list of major threats to listed species, human disturbance was viewed as the second greatest threat, being mentioned in 20% of the references and identified as a problem for 13 species. Species most harmed by human disturbance are the marsh–wading birds, birds of prey, and marine–shore birds; and species associated with coastal and freshwater wetlands and beaches. Species most often mentioned as suffering from human disturbance were common loons (*Gavia immer*), trumpeter swans (*Cygnus buccinator*), snowy plovers (*Charadrius alexandrinus*), and roseate terns (*Sterna dougallii*).

196. VACCA, M. M., AND C. M. HANDEL. 1988. Factors influencing predation associated with visits to artificial nests. Journal of Field Ornithology 59:215–223.

Artificial goose nests were used to determine what factors increase predation from visits to nests of cackling Canada geese (*Branta canadensis minima*) by researchers. Leaving the nest uncovered, marking the nest location with a flag, or placing the nest on an island or peninsula were examined as possible hazards. Predators destroyed more of the nests with eggs exposed to view (61%) than of the nests with eggs covered with goose down (35%; $P < 0.05$). The rate of predation was only slightly higher among nests on peninsulas than on islands, and equal proportions of flagged and unflagged nests were destroyed. Investigators seemed to attract predators and caused an increase in predation at uncovered nests immediately after a visit to the nest. Covering the eggs with down seemed to negate the attraction of predators after visits by researchers. Among 46 destroyed nests, 78% were destroyed by birds and 22% by mammals. Islands seemed to provide refuge from mammalian predators. Investigators should minimize their influence on nesting success and measure its extent as part of their studies.

197. VAN DER ZANDE, A. N., W. J. TER KEURS, AND W. J. VAN DER WEIJDEN. 1980. The impact of roads on the densities of four bird species in an open field habitat—evidence of a long-distance effect. Biological Conservation 18:299–321.

(We decided to include this paper although it does not deal with waterfowl because it may be of use to researchers of disturbance.)

On page 308 of this publication, two concepts, disturbance distance and disturbance intensity, are introduced. Roads may affect animal communities in various ways. One such way is disturbance, or emission of stimuli to which animals may respond by avoiding the vicinity of the road. The extent, intensity, and mechanism of this effect is almost entirely unknown.

198. VANDER ZOUWEN, W. J. 1983. Waterfowl use and habitat changes of a refuge in southern Wisconsin: 1947–1980. M.S. thesis, University of Wisconsin, Madison.

Although human activity is not a norma ponent of habitat, it affects waterfowl use of the University Bay refuge. For example, on 6 and 9 November 1964, 2,200 and 960 ducks departed the bay when an angler motored through the area used by waterfowl. During observation periods in 5 years that disturbance was recorded, human activity resulted in departure of 44% ducks in 1953, 27% in 1957, 32% in 1960, 33% in 1964, and 43% in 1973. Shore activity increased substantially since the 1960's because of development of land adjacent to the bay. A profound increase in jogging in the early 1970's increased disturbance along the south and west shores and on the Picnic Point peninsula on the north shore. Anglers and boaters were reported as major disturbances in the 1960's. Subsequent to the 1970's the university rowing team has been the major disturbance.

199. WARD, D. H., AND R. A. STEHN. 1989. Response of brant and other geese to aircraft disturbance at Izembek Lagoon, Alaska. U.S. Fish and Wildlife Service, Alaska Fish and Wildlife Research Center. Final report to the Minerals Management Service. Anchorage, Alaska. 193 pp.

Brants (*Branta bernicla*), Canada geese (*Branta canadensis taverneri*), and emperor geese (*Chen canagica*) interrupted foraging and flew up in response to helicopters. Disturbance by aircraft may be harmful to brants. During 1,912 h of daylight observations, 1.07 potential disturbances occurred per hour. Aircraft (0.57 per hour) and persons on foot (0.06 per hour) were the most frequent human-related disturbances. Of all disturbances, bald eagles (*Haliaeetus leucocephalus* Linnaeus) and boats elicited the greatest responses from brants. Canada and emperor geese responded most to bald eagles and persons on foot. According to data grouped by altitude and lateral distance to the flock, brants and emperor geese reacted similarly to different types of aircraft and were more responsive than Canada geese. Noise rather than visual cues triggered responses. For each additional daily disturbance by aircraft throughout a 54-day fall staging period, the predicted total weight gain is reduced by 7.4 g, equivalent to energy expended in 53 min or 73 km of migratory flight. Ten daily disturbances reduced body weight by 4% from the expected departure weight at the Izembek Lagoon.

200. WEIGAND, J. P., M. J. POLLOK, AND G. A. PETRIDES. 1968. Some aspects of reproduction of captive Canada geese. Journal of Wildlife Management 32:894–905.

During daily feeding and collecting of eggs, farm workers created some disturbance of Canada geese (*Branta canadensis*). Geese become accustomed to this intrusion. Although they responded to the intruders with displays every day, the birds did not desert their nest because of the disturbance.

201. WHEELER, W. E., R. C. GATTI, AND G. A. BARTELT. 1984. Duck breeding ecology and harvest characteristics on Grand River Marsh Wildlife Area. Wisconsin Department of Natural Resources Technical Bulletin 145. 49 pp.

A 9% abandonment rate was due to human disturbances resulting from nest trapping or the death of the hen.

202. WHITE-ROBINSON, R. 1982. Inland and saltmarsh feeding of wintering brent geese in Essex. Wildfowl 33:113–118.

Disturbance of brants (*Branta bernicla*) can be measured by the number of times per hour a flock is disturbed and the resultant amount of time it spends flying. Disturbance levels on the saltmarsh may have been biased because of the occasional testing of explosives at a nearby factory for which no correction could be made. Flights in response to disturbance were more frequent on the saltmarsh, but lasted a shorter time than those on farmland. Refuge areas on permanent pasture and saltmarsh combined with intensive hazing of the birds over sensitive crops will maximize the benefit to the birds and considerably reduce their energy expenditure. If the value of feeding in refuge areas is improved, the rate of energy intake is expected to increase and further attract birds to these areas.

203. WILLIAMS, C. S., AND W. H. MARSHALL. 1937. Goose nesting studies on Bear River Migratory Waterfowl Refuge. Journal of Wildlife Management 1:77–86.

Loss of clutches from desertion of nests by five Canada geese was 4%. Some of the eggs in two nests were destroyed and the remainder were then deserted. Three complete clutches were abandoned. The cause of the desertion of one nest was unknown, but may have been nest hunting. Visiting photographers and the operation of a dragline caused the other two desertions.

204. WILLIAMS, G., AND J. E. FORBES. 1980. The habitat and dietary preferences of dark-bellied brent geese and widgeon in relation to agricultural management. Wildfowl 31:151–157.

On weekdays, a road was in regular use by traffic to and from the construction site of an electricity substation. Farm vehicles used the road at irregular intervals every day. Flocks of brants (*Branta bernicla*) soon became accustomed to traffic and frequently foraged within 10 m of the road. The birds foraged close to banks and often allowed humans to approach as close as 50 m before taking to the air. In contrast, Eurasian wigeons (*Anas penelope*) usually foraged well away from the road and banks. Only on weekends when traffic on the road was at a minimum did the wigeons forage on the slurry-treated grassland or winter barley near the road. Because of this intolerance of disturbance the Eurasian wigeons foraged on the less disturbed, but nutritionally poorer unimproved grassland during the week. Disturbance thus can mask food preferences. Disturbance and the nutritional value of grassland principally control the availability of foraging sites for brants and Eurasian wigeons.

205. WISELEY, A. N. 1974. Disturbance to snow geese and other large waterfowl species by gas-compressor sound simulation, Komakuk, Yukon Territory, August–September 1973. Chapter III *in* W. W. H. Gunn, W. J. Richardson, R. E. Schweinburg, and T. D. Wright, editors. Studies on snow geese and waterfowl in the Northwest Territories, Yukon Territory and Alaska, 1973. Arctic Gas Biological Report Series, Vol. 27.

Responses of snow geese (*Chen caerulescens*) to the simulated sound of gas compressors were studied at Komakuk, Yukon Territory. The primary objective was to learn whether migratory snow geese along the Arctic coastal plain are affected by the sound and become used to it. Although reduced from its maximum volume, the noise of the sound simulators caused snow geese and tundra swans (*Cygnus columbianus*) to break their flight formations, flare, increase altitude, increase calling behavior, change speed, and (or) land. Snow geese that were both vertically and horizontally nearer the simulators reacted to sound more frequently; feeding flocks of geese approached the simulator's side where the sound was most intense no closer than 800 m (0.5 mile).

206. Woodall, P. F. 1983. A quantitative analysis of some winter habitats of the red-billed teal, *Anas erythrorhyncha*, in Zimbabwe. South African Journal of Wildlife Research 13:41–46.

Such variables as area of water, pH, conductivity, turbidity, benthic and neustic organisms, plant cover, and disturbance index were recorded in winter from 19 dams. In univariate analysis, area of water, pH, and a disturbance index differed between dams with and without red-billed teals. When red-billed teals were present, their numbers correlated with chironomids and seeds of *Polygonum* sp. For multivariate discriminant function analyses, area of water and disturbance were identified as important variables, and turbidity, pH, and conductivity were less important. Seven categories of disturbance (human presence, swimming, boating, fishing, shooting, irrigation, watering cattle) and two of attraction (feeding, domestic or pinioned ducks) were established and ranked 0–3 (nil, slight, moderate, extensive). Past disturbance was important and was determined based on experience with use of the dams and the signs of recent human or bovine presence. A disturbance index was calculated as:

> Disturbance Index = (total present disturbance − total present attraction) + (total past disturbance − total past attraction).

207. Wooten, W. A. 1954. Waterfowl losses in the surf along the northern California coast. Journal of Wildlife Management 18:140–141.

Sanding, or the presence of mud sand in the surf is a natural phenomenon, and resting ducks in rafts from 200 to 3,000 birds become fouled with sand. Ducks are northern pintails (*Anas acuta*), American wigeons (*A. americana*), green-winged teals (*A. crecca*), mallards (*A. platyrhynchos*), lesser scaups (*Aythya affinis*), redheads (*A. americana*), and canvasbacks (*A. valisineria*). Sanding occurs when the surf at low tide roils steep sandy beaches. Excessive losses of birds usually occur in moderately rough seas immediately after storms and heavy fog off shore. Loss of waterfowl from sanding usually occurs several times during the year, but is prevalent mainly during the hunting season. At these times the birds seek sanctuary in the ocean as an escape from hunters who harass them regularly on inland feeding areas. During the 2-months of this study, 6,000–9,000 birds may have perished along 40 km (25 miles) of beaches.

208. Yocom, C. F., C. L. Buechele, and S. W. Harris. 1956. Great Basin Canada goose nesting populations at the former Lake Lenore National Wildlife Refuge, Washington. Murrelet 37:14–17.

The general lack of breeding success of Canada geese (*Branta canadensis*) on inner islands was attributed to nearby human activity on shore and (or) disturbance from curious anglers who were allowed to use this portion of the lake during the nesting season. If each pair raised 3 to 4 young successfully, an increase of 150–200 birds per year are added to the population. Everything necessary should be done to maintain nesting geese; the fishing season should be timed so that Canada geese remain undisturbed during the breeding season.

209. Ziegler, G. 1981. Zum Einfluß von Störungen durch Angler auf Stockentenbestände an Kiesteichen im Wesertal (The influence on the mallard [*Anas platyrhynchos*] population on gravel pits of disturbances caused by anglers.) Charadrius 17:127–130.

Adverse effects on the biosphere of waters from the steady increase in the number of anglers is now more often mentioned. Information has been scarce on the effects of anglers on ducks during the molting, resting (pause in migration), and over-wintering seasons. The paper addresses the Häverner Marsh, which consists of eight flooded gravel pits that during the last 25 years were opened, enlarged, and, because of technical advances, recultivated in recent years. One of the pits is still being quarried, and angling is not allowed there because of safety concerns. Ziegler graphs the annual abundance of mallards and relates it to the presence of anglers. Since late summer in 1978, angling has been suspended on four government-owned gravel pits serving as wildlife preserves. The suspension continues except for the pond Wilddiebereien. Except during the molting season, mallards can avoid the disturbances on the fished ponds. Without restrictions on angling, disturbances of waterfowl cannot be prevented. The paper ends by citing Ratzburg (1972) that at least 20% of the gravel pits have to be set aside as nature preserves. (Translated from German)

210. ZIEGLER, G. 1987. Zur Entstehung eines Mauserplatzes der Reiherente (*Aythya fuligula*) von überregionaler Bedeutung im nördlichen Westfalen (Development of a supra-regional molting-site of the tufted duck (*Aythya fuligula*) in northeastern Westfalia). Die Vogelwelt 108:67–70.

About 1980, the tufted duck began to use a gravel-pit reserve, Häverner Marsh, as a molting site. As many as 350 adult ducks are in the marsh in June–August during post-breeding and the start of pre-breeding molt. The ducks are probably attracted by high densities of zebra mussels (*Dreissena polymorpha*) and lack of human disturbance, but hunting in this marsh harms the ducks. In 1979, rules were passed for nature preserves. The rules prohibited access to the banks and angling and have been enforced since 1981. Since March 1986, main entryways into the nature preserves have been closed with barriers when the pits are not mined. The number of molting ducks in the marsh has increased in response to the regulations. The greatest disturbance is hunting, which is allowed by nature preserve ordinances during 1 April–15 November. Hunting pressure in the Häverner Marsh is great. Continued mining of quarries keeps tufted ducks away. Voluntary hunting during only alternating weeks did not attract more ducks. A complete ban on hunting is believed to be necessary where ducks use gravel pits.

211. ZIEGLER, G., AND W. HANKE. 1988. Entwicklung von Stockenten (*Anas platyrhynchos*)-Beständen in dem Häverner Marsch unter dem Einfluβ der Jagd (Influence of hunting on mallard (*Anas platyrhynchos*) population numbers inside the "Häverner Marsh" reserve). Die Vogelwelt 109:118–124.

From 1 September to 15 November, game tenants committed themselves voluntarily to hunting during only alternate weeks in the nature reserves Staustufe Schlüsselburg and Häverner Marsch. Counts of mallard ducks were made 35 times in the Häverner Marsch. The abundance of mallards decreased sharply at the beginning of the hunting season and increased only after 1 week after the end of the hunting season. Hunting did not cease in alternate weeks as promised. Mallards were more numerous on waters without voluntary restriction than on waters where hunting was restricted to alternate weeks. The author believes waterfowl hunting in the Häverner Marsch and in the entire reserve is a severe disturbance of ducks and is out of line with conservation aims of the nature reserve decree and the international commitment by the federal government under the Ramsar Convention.

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[1] Scientific and common names according to Banks, R. C., R. W. McDiarmid, and A. L. Garner. 1987. Checklist of Vertebrates of the United States, the U.S. Territories, and Canada. U.S. Fish Wildlife Service, *Resource Publication* 166. 79 pp. or, American Ornithologists' Union, 1983, Check-list of North American Birds, 6th edition. Allen Press, Inc. 877 pp.

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168. Mourning Dove Nesting: Seasonal Patterns and Effects of September Hunting, by Paul H. Geissler, David D. Dolton, Rebecca Field, Richard A. Coon, H. Franklin Percival, Don W. Hayne, Lawrence D. Soileau, Ronnie R. George, James H. Dunks, and S. Dwight Bunnell. 1987. 33 pp.
169. Saltcedar Control for Wildlife Habitat Improvement in the Southwestern United States, by Theodore A. Kerpez and Norman S. Smith. 1987. 16 pp.
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172. Satellite Telemetry: A New Tool for Wildlife Research and Management, by Steven G. Fancy, Larry F. Pank, David C. Douglass, Catherine H. Curby, Gerald W. Garner, Steven C. Amstrup, and Wayne L. Regelin. 1988. 54 pp.
173. Key to Acanthocephala Reported in waterfowl, by Malcolm E. McDonald. 1988. 45 pp.
174. Obsolete English Names of North American Birds and Their Modern Equivalents, by Richard C. Banks. 1988. 37 pp.
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187. Dusky Canada Goose: An Annotated Bibliography, by Bruce H. Campbell and John E. Cornely. 1992. 29 pp.

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